Table 4-2-8 Freight Transport Volume (Import)

(ton/day)

Category	Import (from China)		Transit (to Russia)		Total	
Oil	882.8	(1,059.4)	–	–	882.8	(1,059.4)
Steel	25.5	(30.6)	–	–	25.5	(30.6)
Construction materials	20.6	(24.7)	8.0	(9.6)	28.6	(34.3)
Wheat and Cereal	136.2	(163.4)	–	–	136.2	(163.4)
Fresh foods	22.8	(27.4)	–	–	22.8	(27.4)
Wool	0.6	(0.7)	6.3	(7.6)	6.9	(8.3)
Fluorspar	–	(–)	285.0	(342.0)	285.0	(342.0)
Chemical materials	8.2	(9.8)	158.4	(190.1)	166.6	(199.9)
Foods	18.4	(22.1)	190.2	(228.2)	208.6	(250.3)
Iron ore	–	–	47.4	(56.9)	47.4	(56.9)
Others	114.8	(137.8)	277.8	(333.3)	392.6	(471.1)
Total	1,229.9	(1,475.9)	973.1	(1,167.7)	2,203.0	(2,643.6)

Note 1: The figures in parentheses indicate the transport volume when the traffic fluctuation during the peak period is estimated to be 20%.

Table 4-2-9 Freight Transport Volume (Export)

(ton/day)

Category	Export (to China)		Transit (to Russia)		Total	
Steel	9.6	(11.5)	1,029.3	(1,235.2)	1,038.9	(1,246.7)
Machine	6.0	(7.2)	126.6	(151.9)	132.6	(159.1)
Construction materials	64.1	(76.9)	–	–	64.1	(76.9)
Wheat and Cereal	13.7	(16.5)	–	–	13.7	(16.5)
Wool	17.0	(20.4)	–	–	17.0	(20.4)
Chemical materials	12.1	(14.5)	158.4	(190.1)	170.5	(204.6)
Fertilizer	132.9	(159.5)	3,167.1	(3,800.5)	3,300.0	(3,960.0)
Wood	207.4	(248.9)	506.8	(608.2)	714.2	(857.1)
Cupper concentrate	109.6	(131.5)	–	–	109.6	(131.5)
Non ferrous	1.6	(1.9)	95.1	(114.1)	96.7	(116.0)
Others	89.0	(106.8)	277.8	(333.4)	366.8	(440.2)
Total	663.0	(795.6)	5,361.1	(6,433.4)	6,024.1	(7,229.0)

Note 1: The figures in parentheses indicate the transport volume when the traffic fluctuation during the peak period is estimated to be 20%.

(2) Number of Freight Cars (for imports)

The number of freight cars by commodity was calculated as follows.

As for the commodities carried by wagons and gondola cars, it was estimated that 50% of each commodity would be carried by each type of car.

As for the commodities carried by both containers and wagons, calculations were made for three cases, with the containerization ration estimated to range from 20 to 80%.

Table 4-2-10 Containerization Ratios by Commodity and by Case

(%)

Item \ Case	1	2	3
Fresh foods	100	100	100
Wool	100	100	100
Wheat and Cereal	50	70	80
Chemical materials	20	30	50
Foods	50	70	80
Others	20	30	50
A (%)	33	46	61

Note 1: "A" indicates the containerization ratio of the commodities (1,154.7 tons in total) other than those listed in this table, excluding oil, steel, construction materials, fluorspar, and iron ore.

The number of necessary cars was calculated, based on the above containerization ratios and also on the types of cars by commodity and average load of freight per car. The result was as shown in Table 4-2-11.

Table 4-2-11 Transport Volume and Number of Necessary Cars by Commodity (Zamyn-Uud Station • Import)

	Transport Volume (tons/day)	Cars		Average load per car (ton)	Case-1			Case-2			Case-2		
		Type	Tare (ton)		Transport volume (tons/day)	Share (%)	No. of cars	Transport volume (tons/day)	Share (%)	No. of cars	Transport volume (tons/day)	Share (%)	No. of cars
Oil	1,059.4	T	21	50	1,059.4	100	21	1,059.4	100	21	1,059.4	100	21
Steel	30.6	G	22	50	30.6	100	1	30.6	100	1	30.6	100	1
Construction materials	34.3	W	24	50	17.2	50	0.5	17.2	50	0.5	17.2	50	0.5
		G	22	50	17.1	50	0.5	17.1	50	0.5	17.1	50	0.5
Wheat and cereal	163.4	W	24	30	81.7	50	3	49.0	30	2	33.0	20	1
		C	2	15	81.7	50	(6)	114.4	70	(8)	130.4	80	(9)
Fresh foods	27.4	C	2	5	27.4	100	(6)	27.4	100	(6)	27.4	100	(6)
Wool	8.3	C	2	10	8.3	100	(1)	8.3	100	(1)	8.3	100	(1)
Fluorspar	342.0	G	22	50	342.0	100	6	342.0	100	6	342.0	100	6
Chemical materials	199.9	W	24	40	160.0	80	4	140.0	70	3.5	100.0	50	2.5
		C	2	15	39.9	20	(3)	59.9	30	(4)	99.9	50	(7)
Foods	250.3	W	24	35	125.2	50	4	75.0	30	2	50.0	20	1.5
		C	2	5	125.1	50	(25)	175.3	70	(35)	200.3	80	(40)
Iron ore	56.9	G	22	50	56.9	100	1	56.9	100	1	56.9	100	1
Others	471.1	W	24	40	188.5	40	5	165.0	35	4	118.0	25	3
		G	22	40	188.5	40	5	165.0	35	4	118.0	25	3
		C	2	10	94.1	20	(10)	141.1	30	(14)	235.1	50	(24)
Total	2,643.6				2,643.6			2,643.6			2,643.6		
Tank car							21			21			21
Wagon							17			12			9
Gondola car							14			13			12
Container					376.7		(51)	526.5		(68)	700.5		(87)
Flat car							26			34			44

Note 1: Based on the precondition that two containers are carried by one flat car.

(3) Movement of Freight Cars at Zamyn-Uud Station

The movement of freight cars at and around Zamyn-Uud station was estimated, in order to utilize the results as a basis for planning freight train operation and yard work.

1) Transport volume of exports and number of necessary cars

Based on the transport volume by commodity, and also under the principle similar to that for the imports, calculations were made for three cases, with the containerization ratio estimated to range from 20 to 80%.

Table 4-2-12 Containerization Ratios by Commodity and by Case

(%)

Item \ Case	1	2	3
Wool	100	100	100
Machine	20	30	50
Wheat and Cereal	50	70	80
Chemical materials	20	30	50
Fertilizer	20	30	50
Others	20	30	50
A (%)	20	31	50

Note 1: "A" indicates the containerization ratio of the commodities (4,800.8 tons in total) other than those listed in this table, excluding steel, construction materials, wood, non-ferrous metal, and copper concentrate.

2) Containerization ratios of commodities

It is assumed that, although the transport volume by containers is small at present due to such reasons as shortage of containers and flat cars, containerization will be greatly promoted toward the year 2000 for commodities suitable for container transport. This time, therefore, the Case-2 was studies for both imports and exports.

Table 4-2-13 Transport Volume and Number of Necessary Cars by Commodity (Zamyn-Uud Station • Export)

	Transport Volume (tons/day)	Cars		Average load per car (ton)	Case-1			Case-2			Case-2		
		Type	Tare (ton)		Transport volume (tons/day)	Share (%)	No. of cars	Transport volume (tons/day)	Share (%)	No. of cars	Transport volume (tons/day)	Share (%)	No. of cars
Steel	1,246.7	G	23	50	1,246.7	100	25	1,246.7	100	25	1,246.7	100	25
Machine	159.1	W	24	35	65.0	40	2	55.5	35	1.5	39.6	25	1
		G	23	35	64.1	40	2	55.5	35	1.5	39.6	25	1
		C	2	10	30.0	20	(3)	48.1	30	(5)	80.0	50	(8)
Construction materials	76.9	W	24	50	38.5	50	1	38.5	50	1	38.5	50	1
		G	23	50	38.4	50	1	38.4	50	1	38.5	50	1
Wheat and cereal	16.5	W	24	30	8.3	50	0.5	4.9	30	0.5	3.3	20	0.5
		C	2	15	8.2	50	(0.5)	11.6	70	(1)	13.2	80	(1)
Wool	20.4	C	2	10	20.4	100	(2)	20.4	100	(2)	20.4	100	(2)
Chemical materials	204.6	W	24	40	163.6	80	4	143.6	70	3.5	102.3	50	2.5
		C	2	15	41.0	20	(3)	61.0	30	(4)	102.3	50	(7)
Fertilizer	3,960.0	W	24	50	3,168.0	80	63.5	2,772.0	70	55.5	1,980.0	50	40
		C	2	15	792.0	20	(53)	1,188.0	30	(79)	1,980.0	50	(132)
Wood	857.1	G	23	45	857.1	100	19	857.1	100	19	857.1	100	19
Cupper concentrate	131.5	G	23	50	131.5	100	3	131.5	100	3	131.5	100	3
Non-ferrous	116.0	W	24	50	58.0	50	1.5	58.0	50	1.5	58.0	50	1.5
		G	23	50	58.0	50	1.5	58.0	50	1.5	58.0	50	1.5
Others	440.2	W	24	40	176.1	40	4.5	154.1	35	4	110.1	25	3
		G	23	40	176.1	40	4.5	154.1	35	4	110.1	25	3
		C	2	10	88.0	20	(9)	132.0	30	(14)	220.0	50	(22)
Total	7,229.0				7,229.0			7,229.0			7,229.0		
Wagon				77			77			68			50
Gondola car				56			56			55			54
Container				(71)	959.2		(71)	1,461.1		(105)	2,415.9		(172)
Flat car				24			24			35			58

Note 1: Based on the precondition that three containers are carried by one flat car.

3) Movement of freight cars

Figure 4-2-2 shows the flows of freight cars for imposts and exports in the Case-2. As shown here export transport volume is larger than that of the imports.

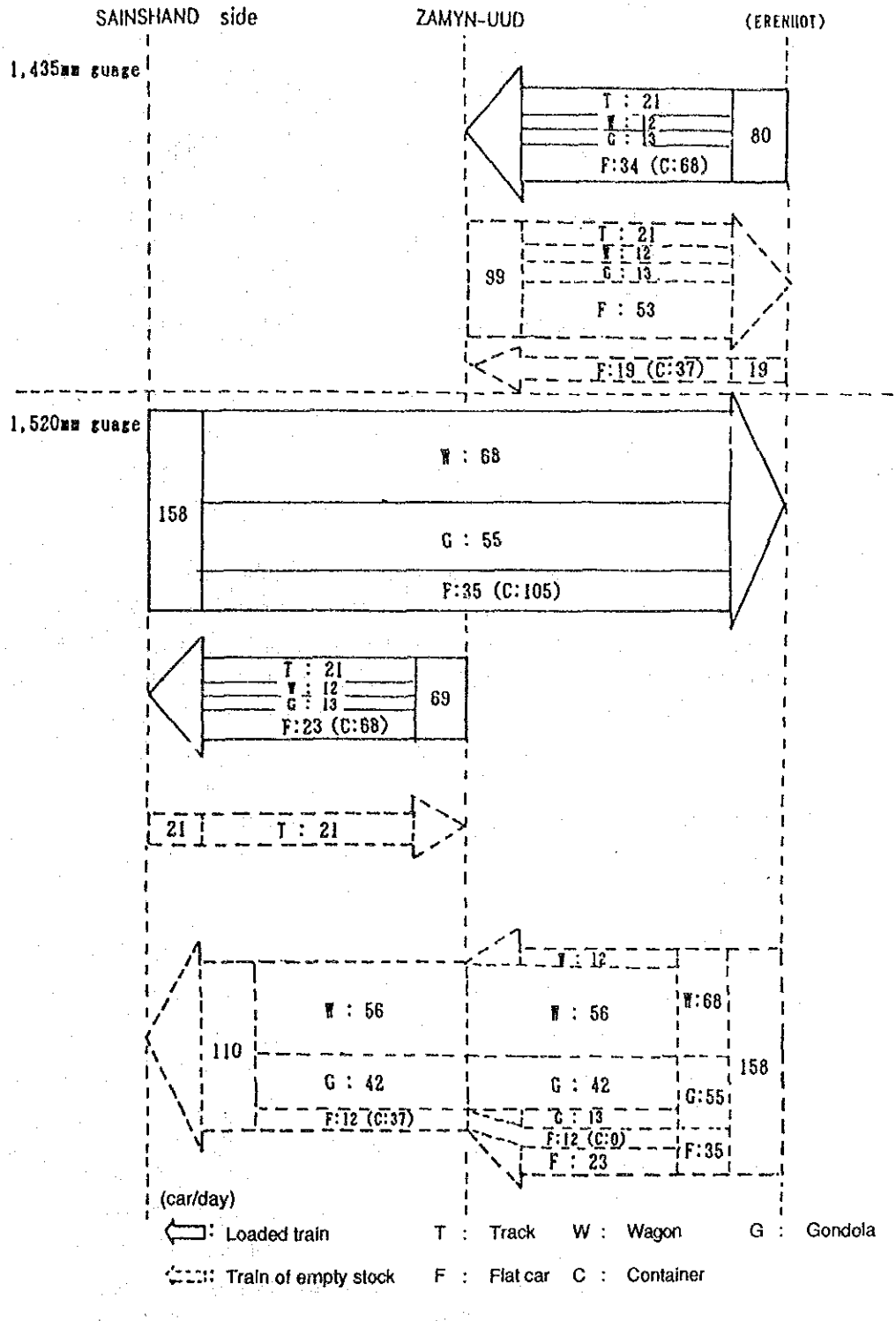


Fig. 4-2-2 Freight Car Flow (2000) (per day)

(4) Train Operation Planning

Based on the movement of freight cars described in (3), a train operation plan was drawn up as follows.

1) 1,435mm gauge

a) Down trains (Erenhot → Zamyn-Uud)

i) Tons carried

Net tons	= 2,643.6 tons	(1)	
Tare load			
Tank cars	21 tons × 21 cars = 441 tons		
Wagons	24 tons × 12 cars = 288 tons		
Gondola cars	22 tons × 13 cars = 286 tons		
Containers	2 tons × 68 containers = 136 tons		
Flat cars	15 tons × 34 cars = 510 tons		
Tare load total (80 cars)	= 1,661 tons	(2)	
Empty cars			
Containers	2 tons × 37 containers = 74 tons		
Flat cars	15 tons × 19 cars = 285 tons		
Empty cars total (19 cars)	= 359 tons	(3)	
Grand total (1) + (2) + (3)	= 4,663.6 tons	(4)	

ii) Number of trains

While the total tons carried is 4,663.6 tons, the hauling capacity per train is 2,000 tons. Therefore, the number of necessary trains will be 2.3 per day. For efficient transport and yard work, it is desirable to separate trains for oil transport from trains for ordinary commodities. Accordingly, it is planned to operate one train for oil (1,059.4 tons + 441 tons = 1,500.4 tons) and two trains for ordinary commodities (1,581.6 tons per train on average).

b) Up trains (Zamyn-Uud → Erenhot)

Up trains are used entirely for carrying empty cars. Since three down trains are to be operated, it is planned to operate three up trains also, taking into consideration efficient locomotive utilization and balanced yard work.

2) 1,520mm gauge

a) Down trains

i) Zamyn-Uud → Ulaan-Baatar side

① Tons carried

Net tons	= 2,643.6 tons	(1)	
Tare load			
Tank cars	25 tons × 21 cars = 525 tons		
Wagons	24 tons × 12 cars = 288 tons		
Gondola cars	23 tons × 13 cars = 299 tons		
Containers	2 tons × 68 containers = 136 tons		
Flat cars	22 tons × 23 cars = 506 tons		
Tare load total (68 cars)	= 1,754 tons	(2)	
(1) + (2)	= 4,397.6 tons	(3)	

Empty cars

Wagons	24 tons × 56 cars = 1,344 tons		
Gondola cars	24 tons × 42 cars = 1,008 tons	.....	(3)
Containers	2 tons × 34 containers = 74 tons		
Flat cars	22 tons × 12 cars = 264 tons		
Empty cars total (110 cars)	= 2,690 tons	.....	(4)
Grand total (3) + (4)	= 7,087.6 tons	.....	(5)

② Number of trains

While the total tons carried is 7,087.6 tons, the hauling capacity per train is 2,600 tons. Therefore, the number of necessary trains will be 2.8 per day. However, it is planned to operate five trains the same as the up trains described later, taking into consideration such factors as efficient utilization of locomotives.

ii) Erenhot → Zamyn-Uud

① Tons carried

On this section, trains are used entirely for carrying empty cars.

Tare load

Wagons	24 tons × 68 cars = 1,632 tons
Gondola cars	23 tons × 55 cars = 1,265 tons
Flat cars	22 tons × 35 cars = 770 tons
Tare load total (158 cars)	= 3,667 tons

② Number of trains

On this section, the hauling capacity per train is 2,000 tons or 49 cars. The number of necessary trains will be 1.9 when viewed from the weight and 3.3 from the number of cars. However, it is planned to operate six trains the same as the up trains described later, taking into consideration efficient locomotive utilization and yard work.

b) Up trains

i) Ulaan-Baatar side → Zamyn-Uud

① Tons carried

Net tons	= 7,229 tons	.....	(1)

Tare load

Wagons	24 tons × 68 cars = 1,632 tons		
Gondola cars	23 tons × 55 cars = 1,265 tons		
Containers	2 tons × 105 containers = 210 tons		
Flat cars	22 tons × 35 cars = 770 tons		
Tare load total (68 cars)	= 3,877 tons	.....	(2)
(1) + (2) (158 cars)	= 11,106 tons	.....	(3)

Empty cars

Tank cars	25 tons × 21 cars = 525 tons	.....	(4)
Grand total (3) + (4) (179 cars)	= 11,631 tons	.....	(5)

② Number of trains

While the total tons carried is 11,631 tons, the hauling capacity per train is 2,600 tons. Therefore, the number of necessary trains will be 4.5 per day. Accordingly, it is planned to operate five trains.

ii) Zamyn-Uud → Erenhot

① Tons carried

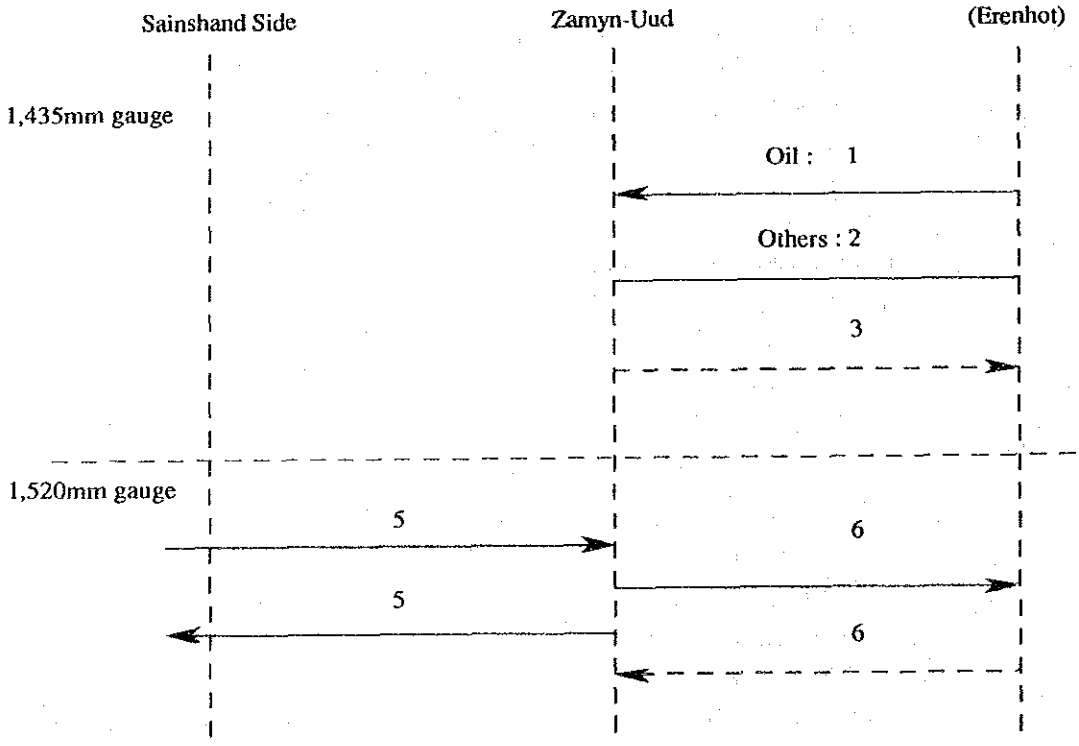
Net tons	= 7,229 tons	(1)
Tare load		
Wagons	24 tons × 68 cars = 1,632 tons	
Gondola cars	23 tons × 55 cars = 1,265 tons	
Containers	2 tons × 105 containers = 210 tons	
Flat cars	22 tons × 35 cars = 770 tons	
Tare load total	= 3,877 tons	(2)
Grand total (1) + (2) (158 cars)	= 11,106 tons	(3)

② Number of trains

While the total tons carried is 11,106 tons (corresponding to 158 cars), the hauling capacity per train is 2,000 tons or 49 cars. Therefore, the number of necessary trains will be 5.6 when viewed from the weight and 3.3 from the number of cars. Accordingly, it is planned to operate six trains per day.

3) Number of freight trains

Figure 4-2-3 shows the number of freight trains operated in the year 2,000.



Note 1: ····· Trains consisting of empty cars.

Fig. 4-2-3 Number of Freight Trains (per day)

(5) Yard Work Planning

1) Flow of yard work

Figure 4-2-4 shows the flow of yard work.

2) Work system of station personnel

The number of the following personnel will increase due to the establishment of freight transshipment facilities.

a) Persons in charge of freight transshipment
   i) Crane operators and their assistants
   ii) Forklift operators and their assistants
   iii) Manual workers for freight haudling

b) Persons in charge of observation and inspection of freight transshipment
   i) Mongolian Railway's employees
   ii) Chinese Railway's employees

c) Interpreters who assist the above persons (b)

d) Persons in charge of freight car shunting in station yards
   i) Yardmend for shunting work in yards with 1,435mm gauge tracks
   ii) Yardmen for shunting work in yards with 1,520mm gauge tracks

e) Persons handling signals and switching devices and persons for liaison with shunting workers
   i) Persons who handle signals and switching devices
   ii) Assistants of the above persons i) ··· Liaison men

f) Guard men for preventing theft of freight, etc.

In addition to the above personnel a) to e), it will become necessary to increase such workers as operation clerks, document transmission clerks, and customs handling clerks.

Figure 4-2-5 shows a station organization plan based on the increase in personnel described above. In this connection, it is planned to maintain the present work system in the future.

3) Assumed train diagram

In drawing up the operation schedule of freight trains, care was taken to operate trains at equal intervals as much as possible. The minimum stopping time at Zamyn-Uud station was set at 3 hours (at present, 2.5 ~ 3 hours), taking into consideration such factors as the shunting work and customs formalities.

4) Model yard-work diagram

Figure 4-2-6 shows an example of a model yard-work diagram in the year 2000.

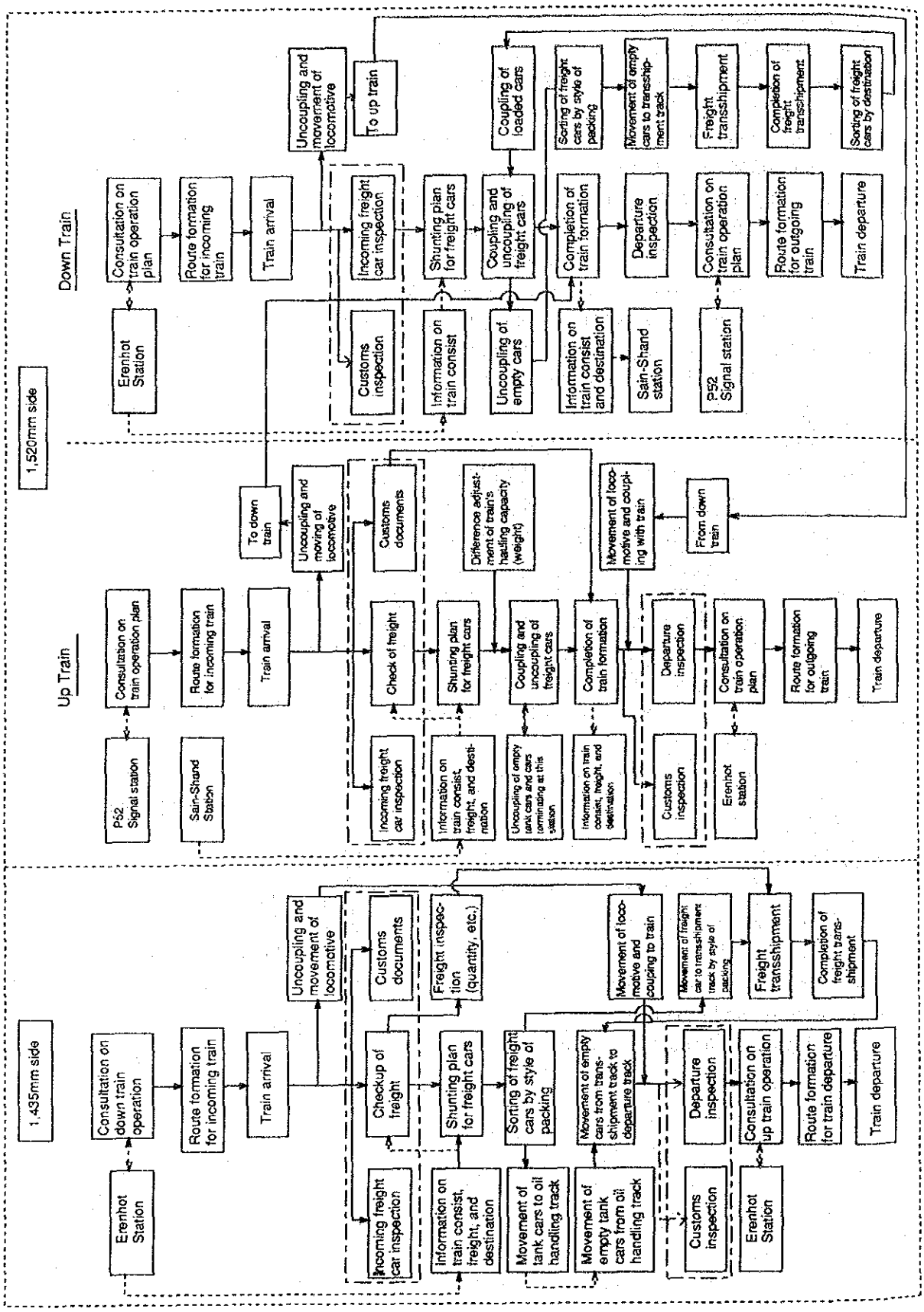
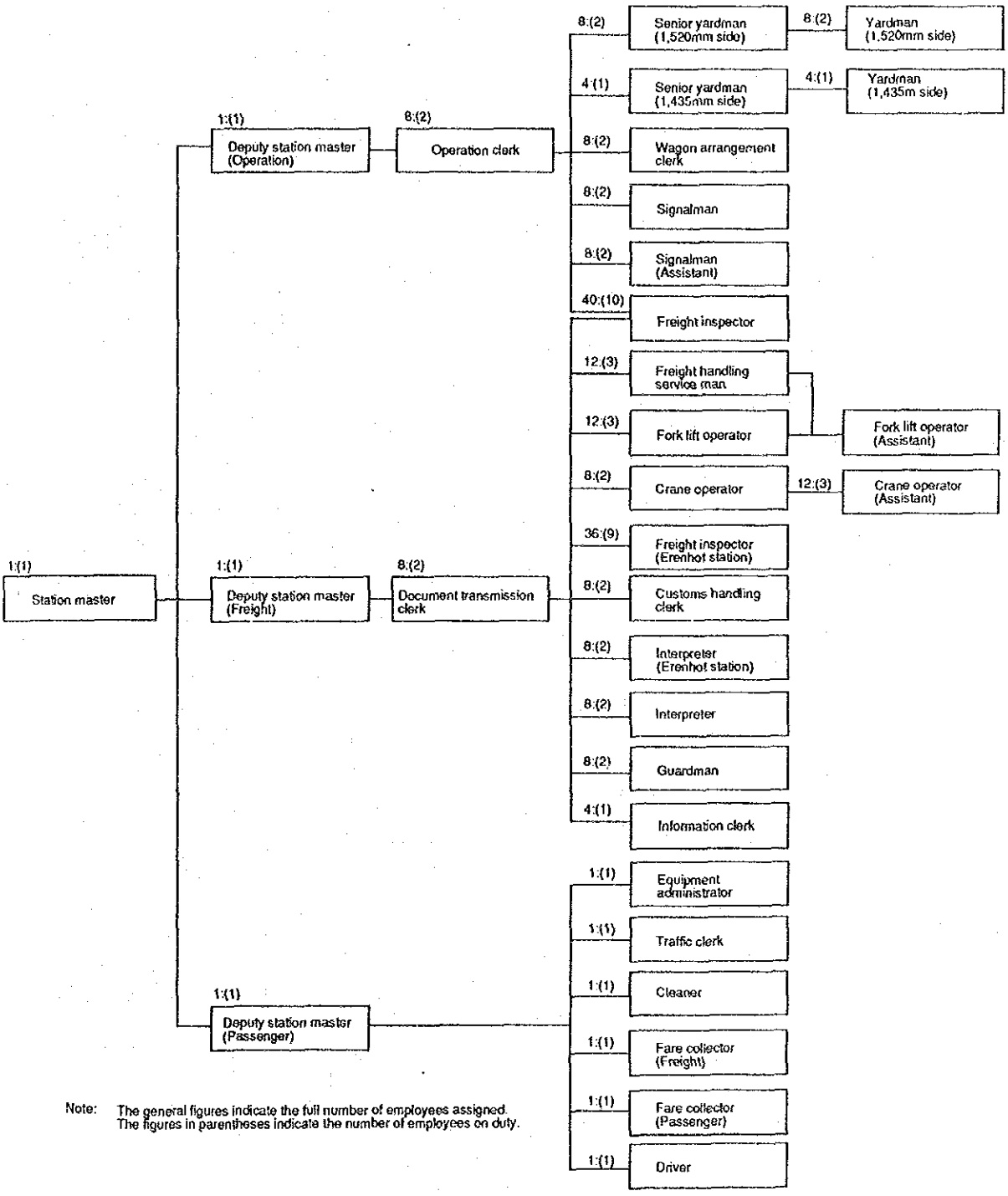


Fig. 4-2-4 Flow of Yard Work at Zamyn-Uud Station



Note: The general figures indicate the full number of employees assigned.
The figures in parentheses indicate the number of employees on duty.

Fig. 4-2-5 Organization Chart of Zamyn-Uud Station (2000)

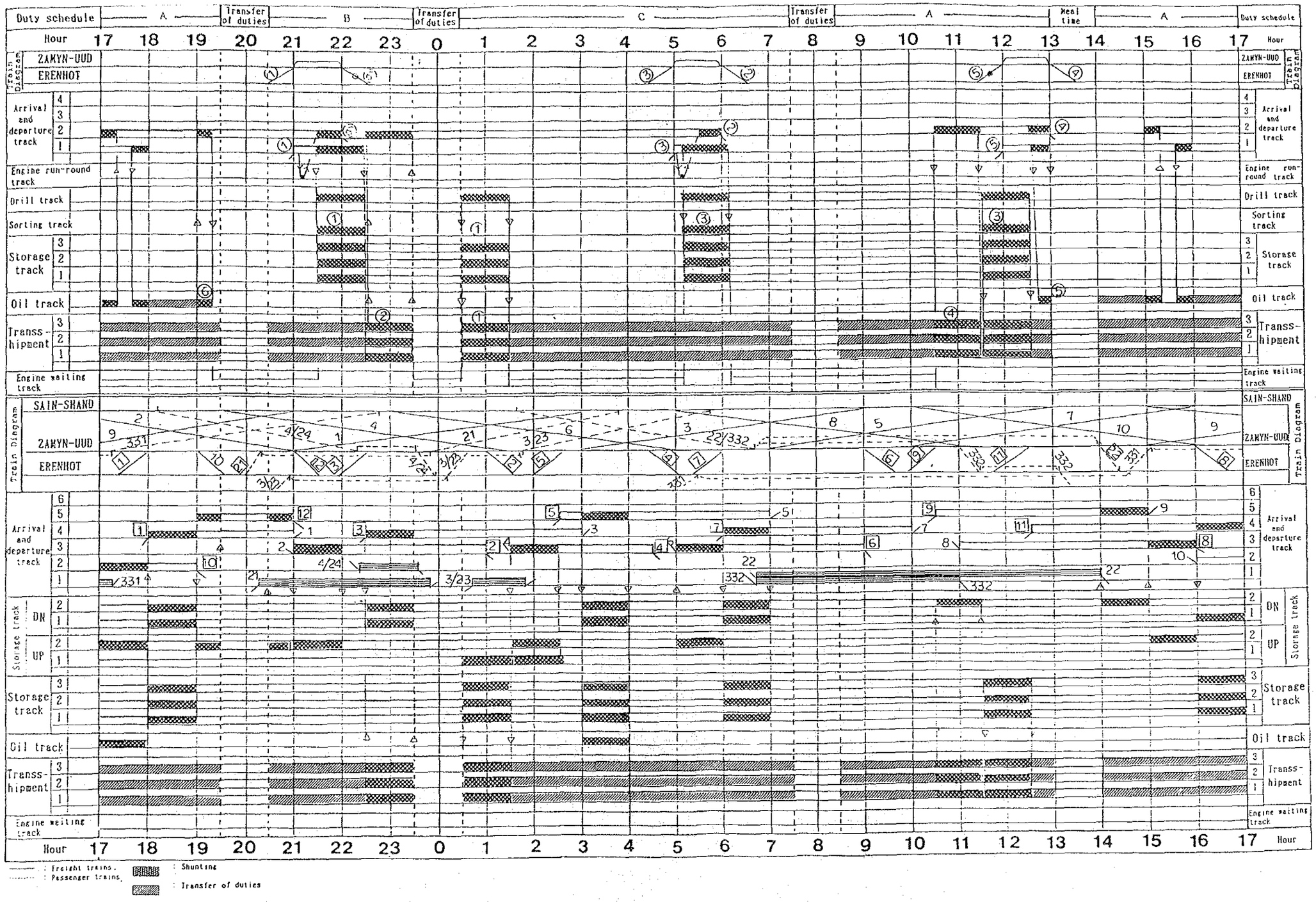


Fig. 4-2-6 Chart Showing Model Occupation of Tracks (Zamyn-Uud Station. 2000)

4-3 Track and Civil Structure

4-3-1 Basic Policy

Our team planned efficient track and civil structure based on the transport plan determined by the transport demands, trying to utilize as many existing facilities as possible. At the same time, the team considered allowance for expansion of the facilities in the future. What we paid attention to includes the following.

1. Transport plan
2. Arrangement to allow efficient transshipment work
3. Utilization of existing facilities
4. Possibility for future expansion
5. Durability against the severe natural conditions
6. Environmental preservation

In planning the facilities, the team also consided the severe natural and environmental conditions and working conditions for employees at the border station.

4-3-2 Preconditions

The preconditions for planning the track and civil structure are as follows.

1. Freight car operation plan according to the freight transport plan in 4-2
2. Train operation plan according to the freight transport plan in 4-2
3. Standard track profile based on the standards of Mongolian Railway
4. Track bed structure based on the standards of Mongolian Railway
5. Track structure based on the standards of Mongolian Railway

4-3-3 Track

(1) Track Layout Plan

Zamyn-Uud station has two major categories of work related to freight transport. One is to transship cargos arrived from China from the 1,435mm gauge cars to the 1,520mm gauge cars. The other is to dispatch 1,520mm gauge cars loaded with export goods to Erenhot and receive empty cars sent back from China. The station appropriates part of these empty cars for loading import goods to be transshipped from Chinese cars and dispatch others unloaded to major freight handling stations into the directions of Sain-Shand. Tables 4-3-1 and 4-3-2 show the flow of freight cars and frequencies of train departure and arrival at Zamyn-Uud station. The eam planned the track layout to allow smooth and efficient transshipment work and freight car operation.

Table 4-3-1 Average Number of Freight Cars Handled per Day at Zamyn-Uud Station in 2000

Category	Number of 1,435mm gauge cars		Number of 1,520mm gauge cars		
	E to Z	Z to E	Z to E	E to Z	Z to S
Tank car	L 21	U 21			L 21 (S to A) (U 21)
Wagon	L 12	U 12	L 68	U 68	L 12 U 56
Gondola car	L 13	U 13	L 55	U 55	L 13 U 42
Flat car	(C 68) L 34 U 19 (C 37)	U 53	(C 105) L 35	U 35	(C 68) L 23 U 12 (C 37)
Subtotal	78	78	158	158	158
Total	99	99	158	158	179
Remarks	Transshipped at Zamyn-Uud		Transshipped at Erenhot		Transshipped at Zamyn-Uud

Note: Z : Zamyn-Uud S : Sain-Shand E : Erenhot
L : Loaded car U : Unloaded car C : Container

Table 4-3-2 Frequencies of Train Departure and Arrival at Zamyn-Uud Station

Category	Sain-Shand to Zamyn-Uud		Zamyn-Uud to Erenhot		Total
Arrival	All loaded	5	All unloaded	6	11
Departure	Loaded and unloaded	5	All loaded	6	11
Total		10		12	22

1) 1,435mm gauge track layout

a) Flow of freight cars

The Chinese locomotive that arrives at Zamyn-Uud from Erenhot hauling a train of loaded cars and a small number of empty cars is separated from the freight cars. After that, the locomotive runs through the locomotive track to be coupled at the head of another train consisting of empty cars, and starts for Erenhot hauling the train. A shunting locomotive, coupled at the head of arrived freight cars, brings the cars to

different platforms after sorting them by category of loaded cargos. The cars from which cargos have been transshipped and become empty are pulled in to a departure and arrival track to be sent to Erenhot.

b) Number and effective length of departure and arrival tracks

b)-1 Number

It is necessary to build three tracks, one each for departure and arrival and another as a turn-out track. One of the three arriving and departing trains is a train to transport petroleum, which is handled at the petroleum transshipment site. Three tracks are sufficient from the viewpoint of the chart showing occupation of tracks.

b)-2 Effective length

The maximum length of the trains is expected to be 49 cars excepting the locomotive according to the allowable hauling load, 2,000 ton, between Zamyn-Uud and Erenhot. Therefore, the team determined the effective length of the tracks for the hauling load of 2,000 ton, and the average loading rate as given in Table 4-3-3 according to the transport plan in 4-2. In this case, the maximum number of hauled freight cars is

$$2{,}000 \text{ ton} \div 41 \text{ ton/car} = 49 \text{ cars}$$

Therefore, the effective length of the tracks is

$$15.52\text{m/car} \times 49 \text{ cars} + 17.4\text{m} + 35\text{m} = 820\text{m}$$

where 17.4m is the length of locomotive and 35m is for allowance.

The effective length of existing departure and arrival tracks, 820m, satisfies this requirement.

Table 4-3-3 Average Weight and Length of Cars for Import Goods

	N	W	TW	AL	TL	LE	TLE
Tank	21	21.0	441.0	50	1,059.4	14.54	305.34
Wagon	12	24.0	288.0	37.2	446.2	16.44	197.28
Gondola car	13	22.0	286.0	47.0	611.6	14.9	193.7
Container empty	34	15.0	510.0	19.5	662.4	15.46	525.64
Container loaded	19	15.0	285.0	3.9	74.0	15.46	293.74
Including tank car	99		1,810.0	–	2,853.6	–	
Excluding	78		1,369.0	23.0	1,794.2	15.52	1,210.36

Note 1: N : Number of cars handled (car)
W : Weight of car (t)
AL : Average load (t/car)
TL : Total load (t)
LE : Length of car (m)
TLE : Total length of cars (m)

Note 2: The petroleum transport train is assumed to be composed of tank cars alone.

Note 3: Average weight per car when tank cars are excluded is
(1,369.2 + 1,794.2) t/78 cars = 41 t/car

c) Number and effective length of draw-out tracks

c)-1 Number

One of the three arriving and departing trains is a train to transport petroleum, which is handled at the petroleum transshipment site. Therefore, only two arriving train needs sorting for entry into a platform track. Sorting work is necessary after the transshipment work. This means that it is sufficient to prepare only one draw-out track.

c)-2 Effective length

When a train of maximum hauling load is divided into two sets, the effective length is

$$49/2 \times 15.52\text{m} + 17.4\text{m} + 25\text{m} = 440\text{m}$$

where 17.5m is the length of the locomotive and 25m is for allowance.

When 53 container cars are divided into two compositions, the effective length necessary for pulling them in and out of the container platform is

$$27 \text{ cars} \times 15.46\text{m/car} + 17.4\text{m} + 25\text{m} = 460\text{m}$$

From these calculations, we adopt 460m as the effective length.

c)-3 Effective length of the draw-out track for petroleum transport train

To accommodate half of 21 tank cars, the effective length of the turn-out track is

$$11 \text{ cars} \times 14.54\text{m} + 17.4\text{m} + 25\text{m} = 210\text{m}$$

d) Number and effective length of sorting tracks

d)-1 Number

i) Number of sorting tracks for entry into a platform track

To move the arrived cars to different platforms, wagons are sorted into three categories, loaded with foodstuff, industrial goods and others, and container cars into two groups, loaded and unloaded. This makes six categories including gondola cars. In this case, the number of sorting tracks N is given by the following equation.

$$N = S^{1/2} + 1 = 6^{1/2} + 1 = 4$$

ii) Number of sorting tracks for train composition

Loaded cars become empty when the cargos have been transshipped. These cars are composed into a train to be sent back to China. In this case, sorting tracks are not necessary.

d)-2 Effective length

Since the number of cars handled per day is $78 \times 2 = 156$ according to Table 4-3-1, the necessary length of the track lt for sorting cars other than tank cars is

$$lt = \frac{156(\text{car/day}) \times 15.52(\text{m/car})}{3(\text{times}) \times 0.7(\text{allowance})} = 1{,}153\text{m}$$

The necessary length of a sorting track is

$$l = \frac{1{,}153\text{m}}{4} + 20\text{m (allowance)} = 310\text{m}$$

The effective length is, therefore,

- Sorting tracks : 3 tracks l = 310m
- A sorting track for entry into a platform track (one of the sorting tracks to accommodate half of container cars) : 1 track

15.46m/car × 27 cars + 20m = 440m

e) Cargo transshipment tracks

We planned different cargo transshipment tracks and platforms for wagons, gondola cars and container cars.

Car to car transshipment is the most efficient. However, this requires synchronization of categories and capacities of cars to be unloaded and loaded. Though car to car transshipment is applicable to the cargos on wagons and gondola cars, since a large number of these cars are available, most of the cargos will be placed on the platform once before they are sorted by packing style and loaded on the Mongolian gauge cars. In this situation, two shifts of transshipment per day will result in confusion of the work on the platform. We determined the lengths of the platforms, therefore, assuming one shift of work even during the busiest time.

On the other hand, a container can be transshipped in about 15 minutes. The number of cranes can be increased to cope with the increase of cargos. For this reason, we assume two shifts of container transshipment work. Temporary extension of working hours can also be adopted when necessary.

From the above, the lengths of platforms for cargo transshipment work are calculated as shown in Table 4-3-4.

Table 4-3-4 Length of Cargo Transshipment Platform

Category	1,435mm		1,520mm	
	Length (m)	Calculation m/car × cars	Length (m)	Calculation m/car × cars
Oil transshipment platform	310	14.4 × 21 + allowance	290	13.57 × 21 + allowance
Roofed high platform	240	16.44 × 12 × 1.2 + 2	240	14.73 × 12 × 1.2 + 2
Open low platform	240	14.90 × 13 × 1.2 + 5	240	14.62 × 13 × 1.2 + 5
Container platform	430	15.46 × 53 × 1/2 + 5	430	19.62 × 35 × 1/2 + 5

2) 1,520mm gauge track layout plan

a) Flow of freight cars

Tables 4-3-1 and 4-3-2 show that the freight cars arriving at Zamyn-Uud from Sain-Shand are all loaded. The allowable hauling load is 2,600 ton and the maximum length

of the train is 55 cars excluding the locomotive. These cars are rearranged to make a train with a hauling load less than 2,000 ton and a length not to exceed 49 cars before sent to Erenhot.

At Erenhot, cargos arrived from Zamyn-Uud are transshipped to Chinese cars. Empty cars thus emerged are sent back to Zamyn-Uud, where they are sorted for use to load cargos from China. Cars loaded and remained unloaded are all sorted according to the destination and composed into trains bound in the direction of Sain-Shand.

b) Number and effective length of departure and arrival tracks

b)-1 Number

Table 4-3-2 gives the frequencies of arrival and departure trains at Zamyn-Uud. The train operation diagram and the track occupation diagram to handle these trains require five departure and arrival tracks and a track as the locomotive track. We planned therefore to lay out six tracks in total.

b)-2 Effective length

The effective length must be 850m for the hauling load of 2,600 ton, and 820m for the hauling load of 2,000 ton which is required to turn out empty cars arrived from China.

c) Number and effective length of draw-out tracks

c)-1 Number

The draw-out tracks will frequently be used for sorting for entry into a platform track, sorting loaded and unloaded cars for train composition and for shunting. We planned laying uncoupling and tracks and sorting tracks next to the departure and arrival tracks. We also planned a draw-out track each for departure and arrival tracks and uncoupling and coupling tracks to allow drawing out in both directions, rearward and forward.

c)-2 Effective length

The effective length is planned to accommodate half of 55 cars, the maximum length of a train.

$$15.0\text{m/car} \times 28 \text{ cars} + 25\text{m (allowance)} = 450\text{m}$$

c)-3 Effective length of draw-out track for petroleum transport train

The arrived empty tank cars must be accommodated to the petroleum transshipment site and brought to the departure and arrival track after they are loaded with petroleum. We planned to do this work as a series of continuous operation. For this reason, the forward draw-out track of the site must have the following length.

$$13.53\text{m/car} \times 21 \text{ cars} + 25\text{m (allowance)} = 330\text{m}$$

d) Number and effective length of uncoupling and coupling tracks

The team planned to build two uncoupling and coupling tracks to allow draw-out in both directions, rearward and forward, adjacent to the departure and arrival tracks to facilitate shunting and sorting of cars. The team planned make these tracks as long as possible in the overall track layout.

e) Number and effective length of sorting tracks

e)-1 Number

1) Sorting track for entry into a platform track

Four or more tracks are necessary, the same as the sorting tracks for 1,435mm gauge cars.

2) Sorting track for train composition

The sorting track for entry into a platform will also be used as the sorting track for train composition.

e)-2 Effective length

Since the number of cars handled per day is $158 \times 2 = 316$ according to Table 4-3-1, the necessary length of the track 1t for sorting cars other than tank cars is

$$1t = \frac{316(\text{car/day}) \times 15(\text{m/car})}{3(\text{times}) \times 0.7\ (\text{allowance})} = 2{,}257\text{m}$$

If we attempted to cope with the demands of sorting with four sorting tracks, the length of a track becomes too large. Thus, the number of the sorting tracks shall be increased to six. The necessary length of a track in this case is

$$1 = \frac{2{,}257\text{m}}{6} + 20\text{m (allowance)} = 400\text{m}$$

When a track accommodates half of the container cars,

$$1 = 19.62\text{m/car} \times 35/2\text{cars} + 20\text{m} = 380\text{m}$$

The effective length is, therefore,

- Sorting track 6 tracks 1 = 400m

f) Uncoupling track to adjust the hauled load

It is necessary to adjust the hauled load, since the allowable hauling loads are different between the sections in the north and south of Zamyn-Uud. This can be done on the rearward and forward draw-out tracks. To do this, an uncoupling track is required for the departure and arrival track. However, the uncoupling and coupling track for tank cars can be used for this purpose.

3) Summary of numbers of tracks

Table 4-3-5 summarizes the discussions in 1) and 2).

Table 4-3-5 Number and Effective Length

Name	1,435mm		1,520mm	
	Number of track	Effective length (m)	Number of track	Effective length (m)
1. Departure & arrival	3	820	6	850
2. Uncoupling & coupling track	–		2	620
3. Sorting track	3	310	6	400
	1	440		
4. Draw-out track	1	460	2	450
5. Draw-out track for tank car	1	210	1	330
Cargo transshipment platform				
1. Roofed high platform	1	240	1	240
2. Open low platform	1	240	1	240
3. Container platform	1	430	1	430

(2) Plan of Platform

The team planned three platforms for cargos in wagons, gondola cars and container cars as explained in (1) Track layout plan.

a) Length of platform

Lengths of the platforms are 240m for wagons, 240m for gondola cars and 430m for container cars as given in Table 4-3-5.

b) Width of platform

b)-1 Platform for wagon

The team planned to handle cargos in wagon on the roofed high platform mainly with small size forklifts. This requires a width of 2.5m to 3.0m for the movement of the forklift.

The team planned a temporary cargo storage space assuming the usage of pallets irrespective of the packing style in consideration of rationalization of cargo handling in the future. This space will frequently be used, since the types of cars are limited and Chinese and Mongolian cars are not necessarily ready for transshipment at the same time.

The average weight of cargos per car is 37 ton and the unit weight of cargos on a pallet is 0.2 to 0.3 ton/m^2. Therefore, the width of the space must be

$$37t/car \div 16.4m/car \div 0.25t/m^2 \simeq 9.0m$$

From the above, we designed the section of the high platform as shown in Fig. 4-3-1.

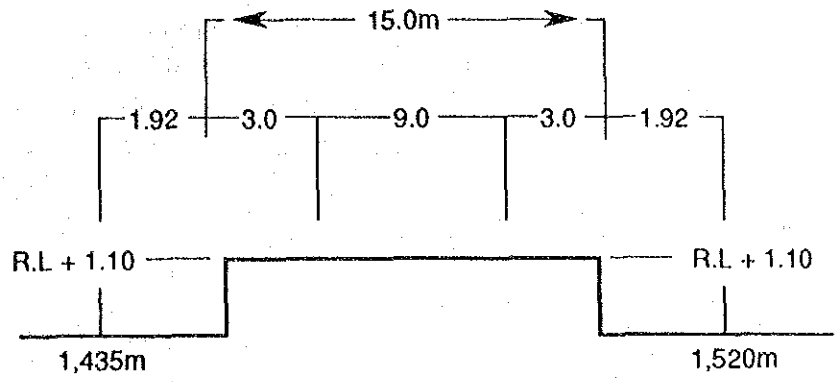


Fig. 4-3-1 High Platform Section

b)-2 Gondola car platform

The team planned to transship cargos in Gondola cars with track cranes on the open low platform. The width of the cargo transshipment zone will be 3 to 4m according to the traffic line of track crane. Cargos transported in Gondola cars will also need a temporary storage space. Taking into account the packing style of bulky cargos, normally packed in bags, the team assumes its weight as 0.4 ~ 0.5t/m^2. Since the average weight of cargos on a car is 47t, therefore, the width of the temporary storage space is

$$47t/car \div 14.9m/car \div 0.4 \sim 0.5t/m^2 \simeq 8 \sim 7m$$

Considering the traffic line of track crane, the team designed the section of the low platform for gondola cars as shown in Figure 4-3-2.

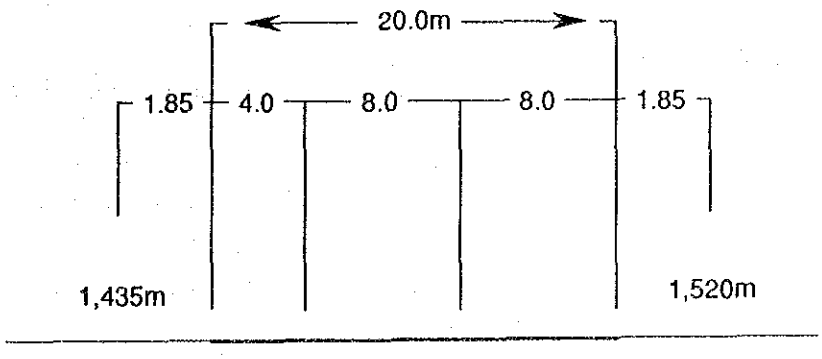


Fig. 4-3-2 Low Platform Section

b)-3 Container platform

The team planed to transship containers with a reach stacker. Tracks are to be laid on the traffic line of the reach stacker to both sides of the platform. In the lateral direction, a length of 6m is spared for a space to store containers in two rows. On each side of the container storage space, a width of 15m is required as the working area for the reach stacker. This makes the platform 36 wide in total. As the result, the section of the container platform becomes as shown in Figure 4-3-3.

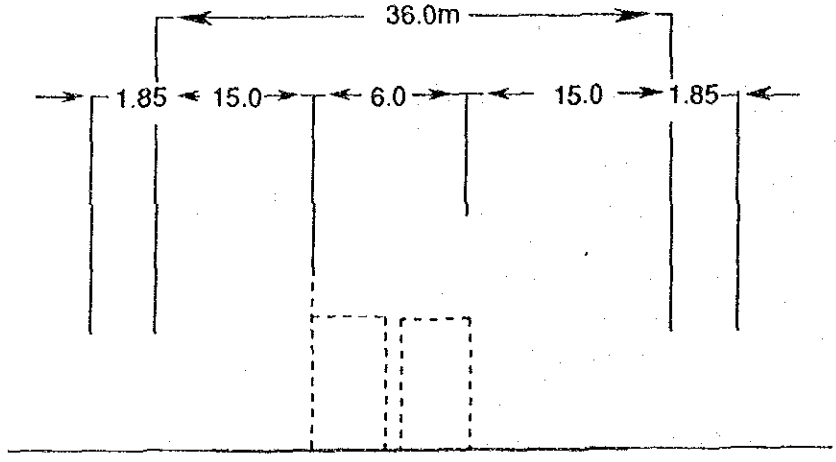


Fig. 4-3-3 Container Platform Section

c) Arrangement of cargo platforms in the sectional direction

To design the arrangement of cargo platforms in the sectional direction, the team reserved allowance for expansion in the future to the side of the low platform to prepare for progress of containerization. For this reason, the team arranged the platforms in the order of roofed high platform, container platform and gondola car platform. The arrangement of platforms in the sectional direction becomes as shown in Figure 4-3-4, in which a passage for workers is also considered.

3) Standard track profile

Track profile is designed in line with the existing tracks of Mongolian Railway basically to its standard.

Major specifications are as follows.

1. Construction gauge : Appendix 4-3-1
2. Rolling stock gauge : Appendix 4-3-2
3. Minimum radius of curve : 200m (Lead radius of 1/9 point)
4. Gradient of track in the station:
   When trains stay or are uncoupled : Level
   When trains do not stay and are not uncoupled : 100/1000 or less
5. Effective length of track : 850m
6. Center to center distance between tracks :
   Main line : 4.10m
   In the station yard : 5.30m

7. Turnout : 1/9, 1/11

Appendix 4-3-3 ~ 4

4) Design of track lay out

From the above (1) to (3), we designed the track lay out as given in Figure 4-3-5 based on the basic policy of track design in 4-3-1 and tried to minimize interference with the existing facilities.

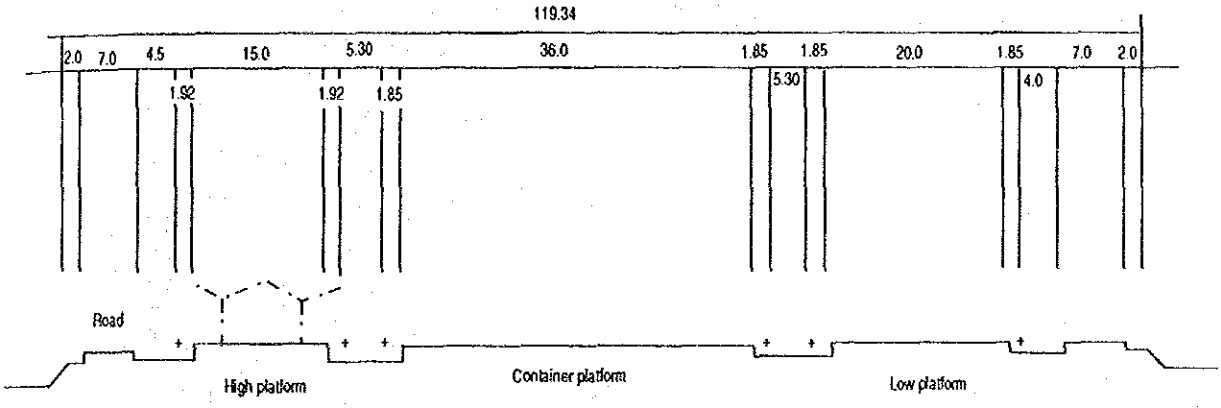
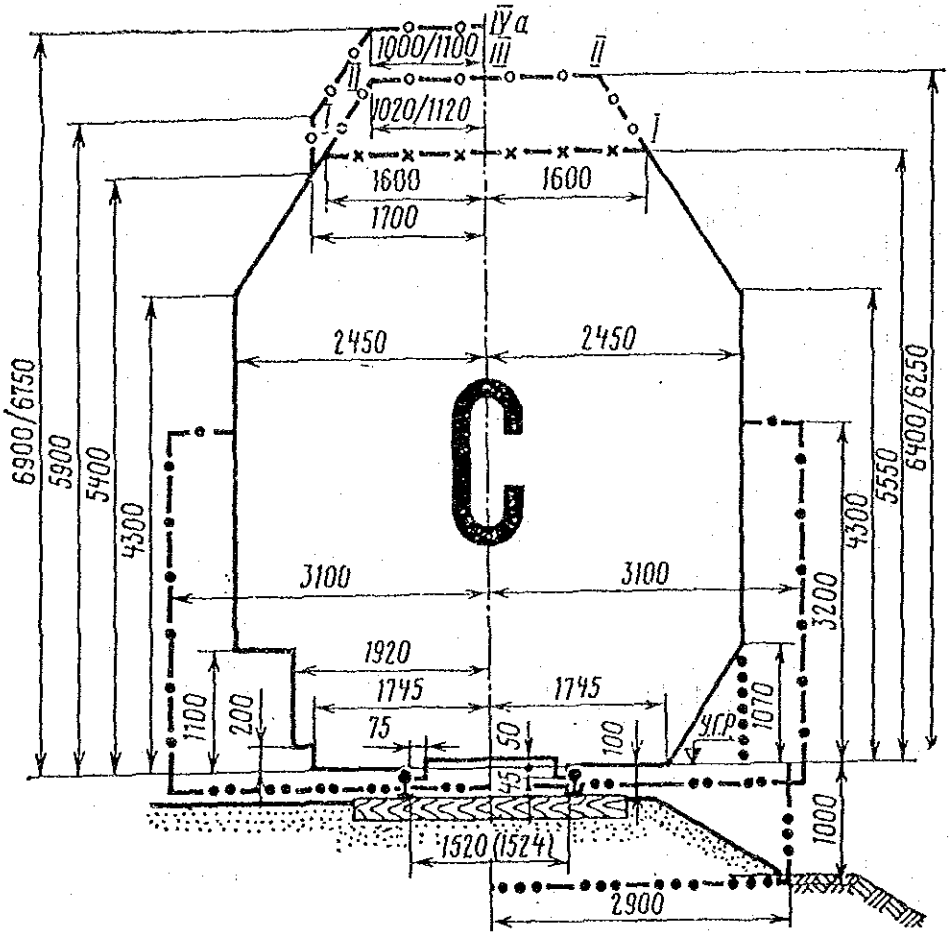
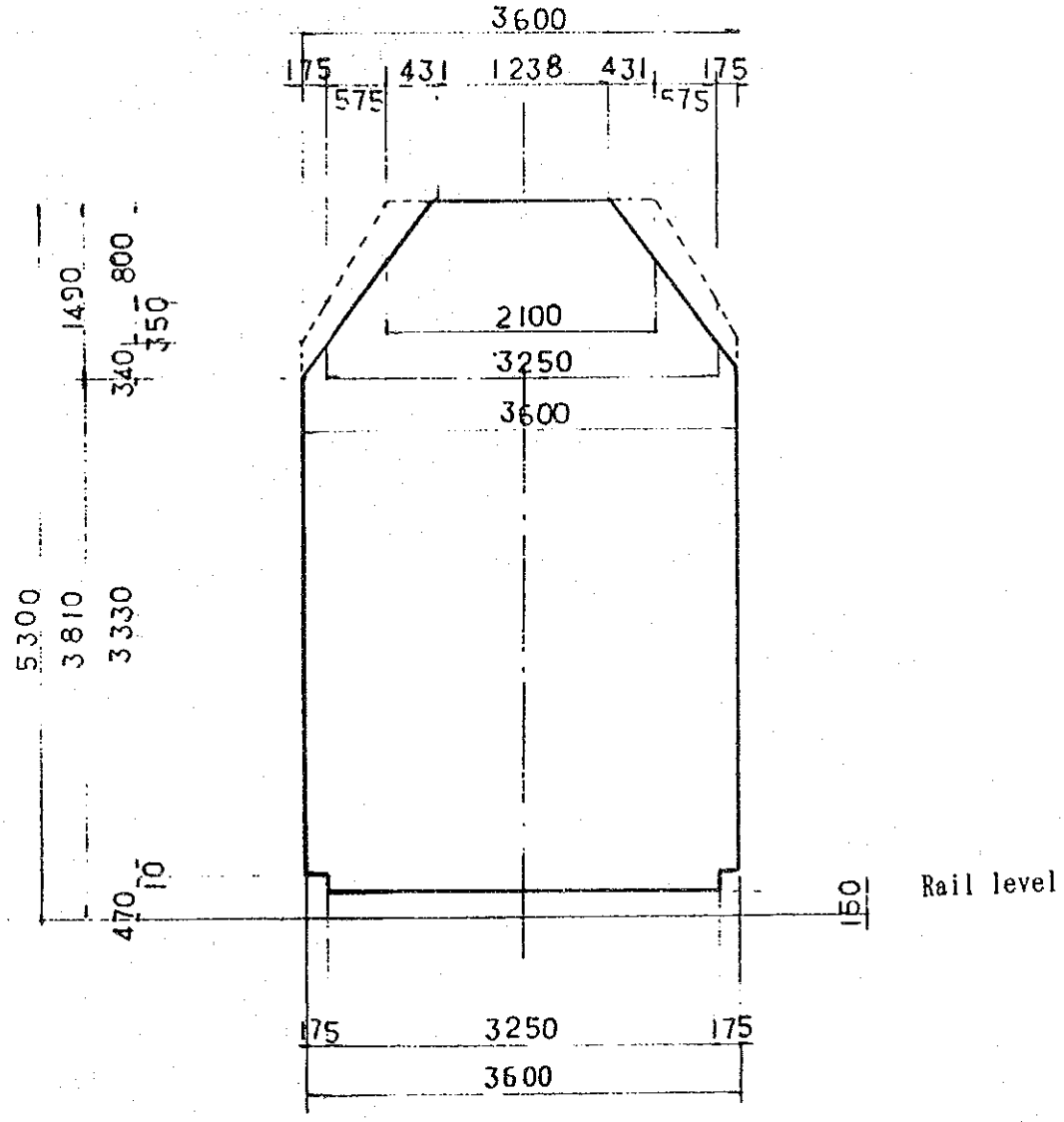


Fig. 4-3-4 Cross Section of Transshipment Yard

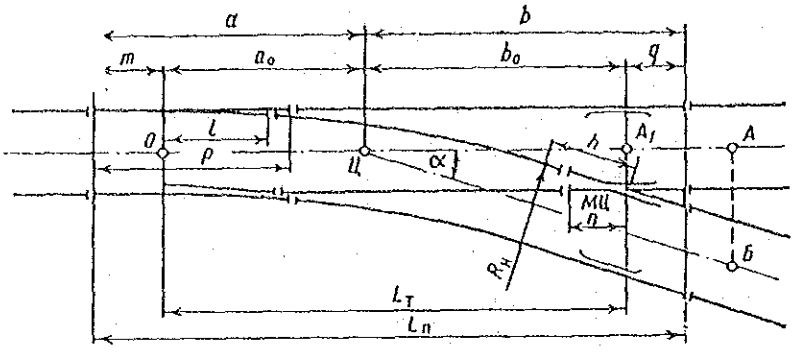
Appendix 4-3-2 Construction Gauge

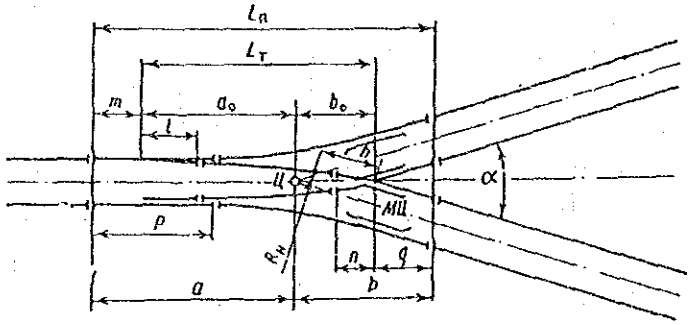


Appendix 4-3-2 Car Gauge



Appendix 4-3-3 Turn Out Skelton



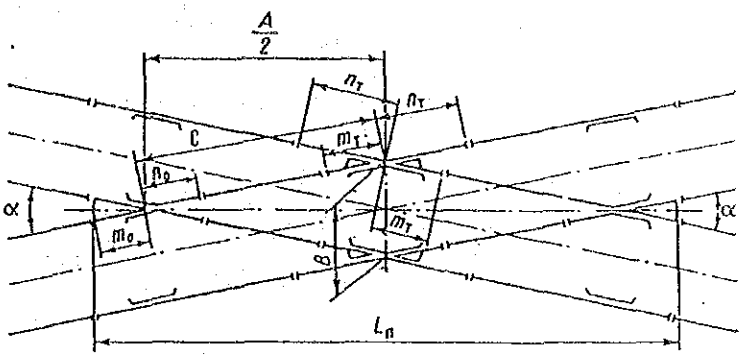


(Unit: m)

Rail	Size	l	p	m	α	n	q	a_o
Simple P50	1/9	6.515	12.500	4.327	6'20'25"	2.055	1.880	11.132
P50	1/11	6.515	12.500	4.327	5'11'40"	2.650	2.300	10.148
Symmetrical P50	1/9	6.515	12.500	4.327	6'20'25"	2.055	1.880	11.431
P50	1/11	6.515	12.500	4.327	5'11'40"	2.650	2.300	9.764

Rail	Size	b_o	h	R_H	L_H
Simple P50	1/9	13.722	2.018	200.000	31.061
P50	1/11	16.754	3.537	297.259	33.529
Symmetrical P50	1/9	13.758	1.912	400.000	31.419
P50	1/11	16.799	5.139	500.000	33.210

Appendix 4-3-4 Main Size of Oblique-Angled Crossing



(Unit: m)

Rail	Size	α	no	mo	nT	mT	A/2	B
Simple P50	2/9	12'40'50"	2.083	1.035	1.245	1.237	6.900	1.533

Rail	Size	c	Ln
Simple P50	2/9	6.943	15.857

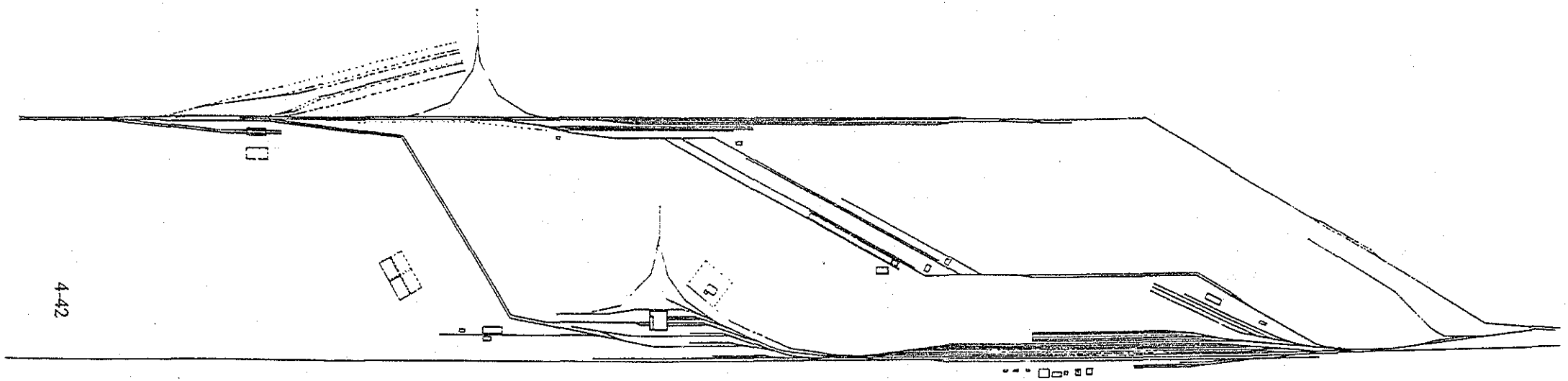


Fig. 4-3-5 Track Layout

4-3-4 Structures

(1) Track Bed Plan

Track bed was designed in line with the existing track facilities of Mongolian Railway basically to its standard. Major specifications are as follows.

1) 1,520mm gauge track

a) Width of formation level

Item	Single track	Double track
Width of formation	6.5m	10.6m

b) Profile of embankment

Section Appendix 4-3-5

2) 1,435mm gauge track

a) Width of formation level

Item	Single track	Double track
Width of formation	6.0m	10.0m

b) Profile of embankment

Section Appendix 4-3-6

(2) Track Plan

Tracks are designed in line with the existing track facilities of Mongolian Railway basically to its standard. Major specifications are as follows.

1. Standard track section : Appendix 4-3-7 and 8
2. Rail : P50 Appendix 4-3-9
3. Fastening devices : Tie plate, large size spike, anti-creeper : Appendix 4-3-9 and 10
4. Sleeper : Wooden sleeper Appendix 4-3-10
5. Track bed : Ballast Appendix 4-3-7 and 8

(3) Sand Barrier

As sand barriers, we build walls shown in Appendix 4-3-11 at appropriate places.

(4) Snow Fence

We build snow fences shown in Appendix 4-3-11 at appropriate places.

(5) Environmental Preservation

To preserve the good environmental conditions, attention was paid, among others, to the following.

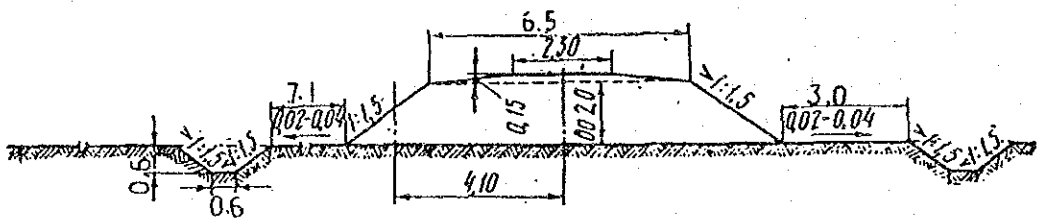
1. Oil and dirt produced from the rolling stock maintenance work.
2. Leak oil from the oil filling station.

3. Debris, waste water and dirt produced at the car washing site.

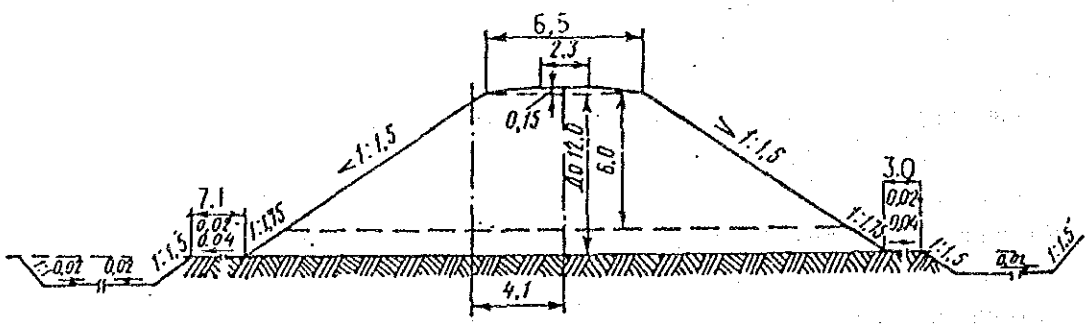
The team planed to install oil reserve tanks for the exhaust in the above paragraphs 1 and 2, and purification facilities for the exhaust in the paragraph 3.

Appendix 4-3-5 Standard Section of Embankment (1,520mm)

h ≦ 2.0m

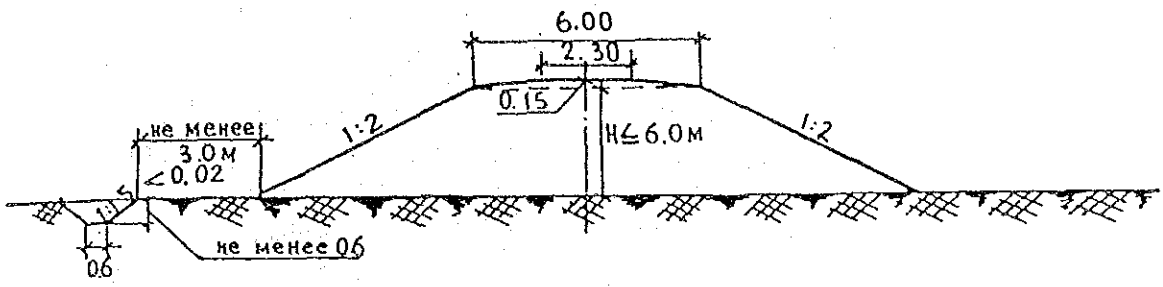


h < 6.0m

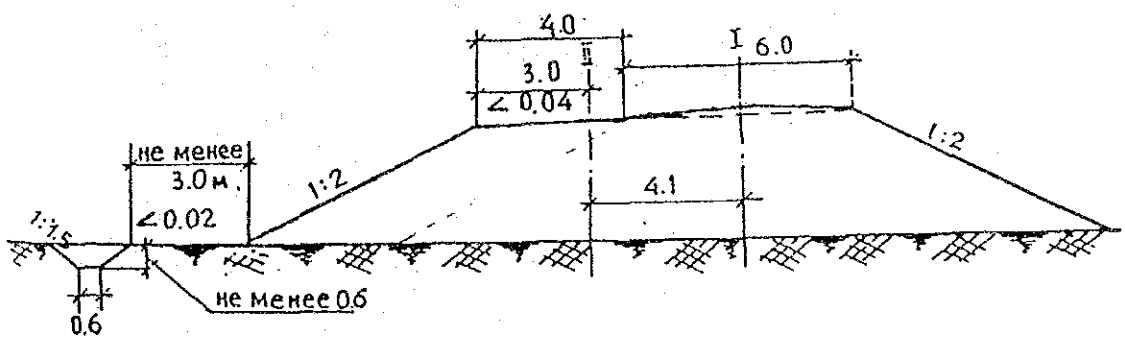


Appendix 4-3-6 Standard Section of Embankment (1,435mm)

Single track

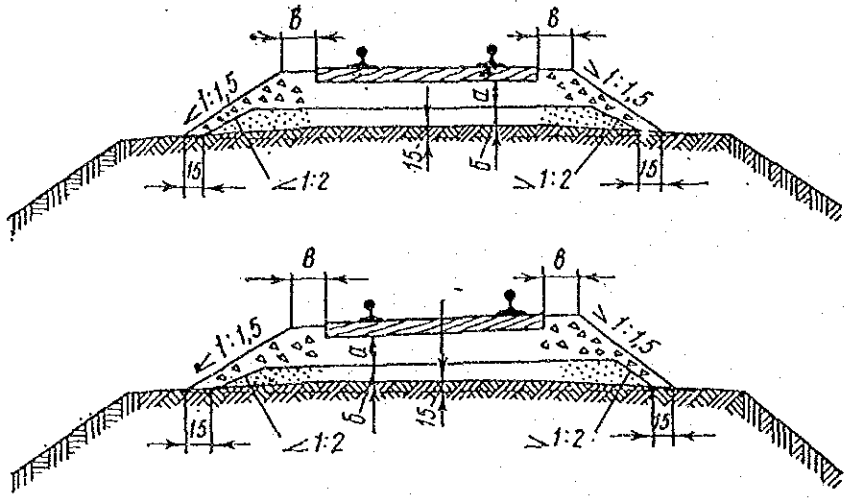


Double track

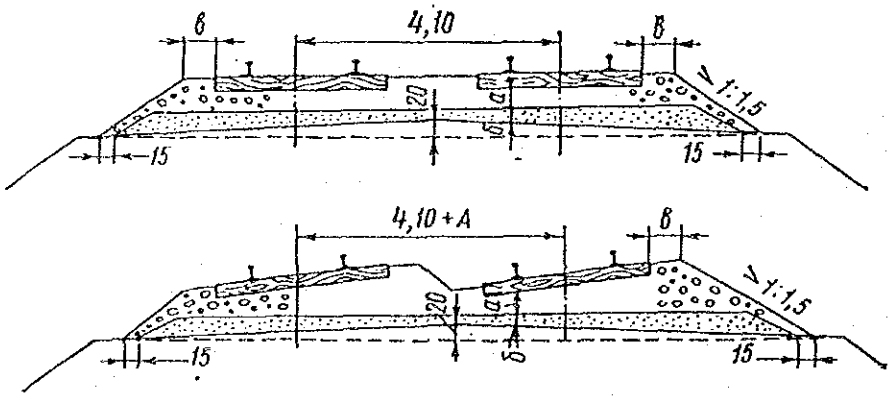


Appendix 4-3-7 Cross Section of Ballast Track (1,520mm)

Single track



Double track

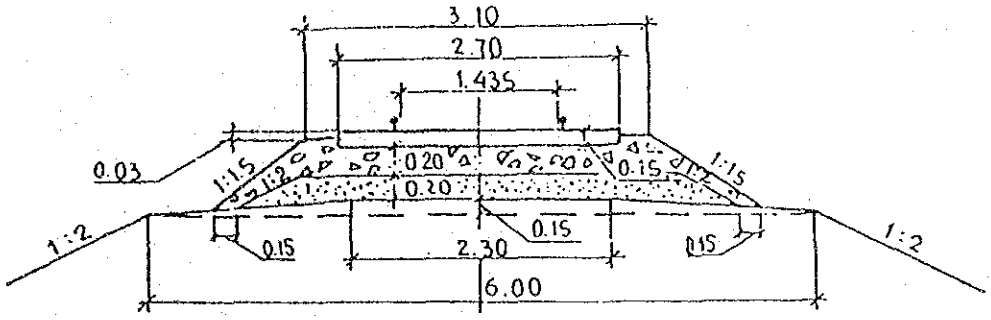


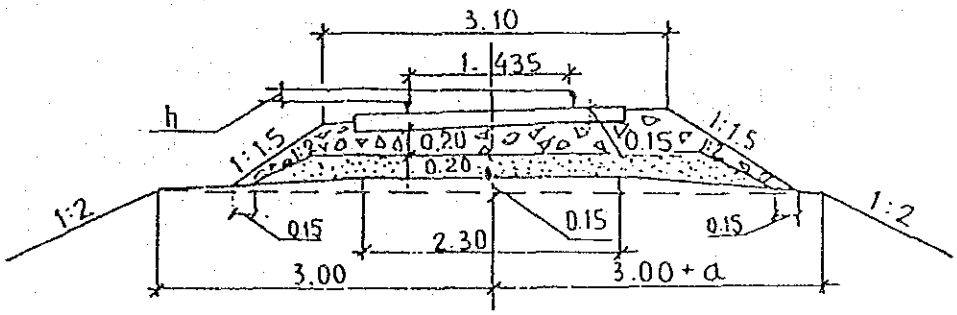
(Unit: cm)

Thickness of Ballast Layer			B
Road metal (a)	Sand cussion (b)	Total	
25	20	45	25

Appendix 4-3-8 Cross Section of Ballast Track (1,435mm)

Single track

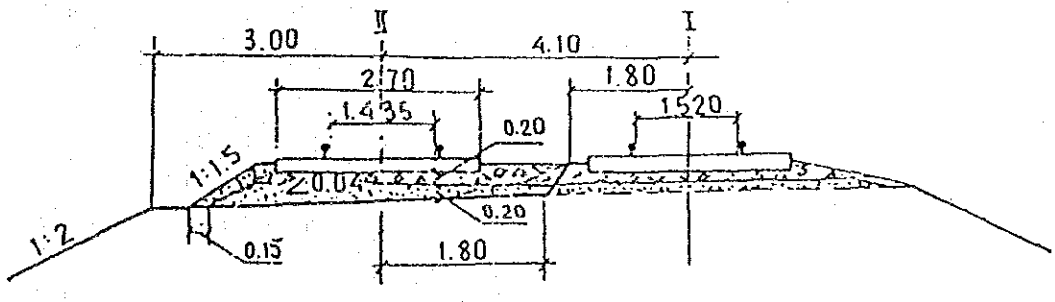




h- rising of outside rail

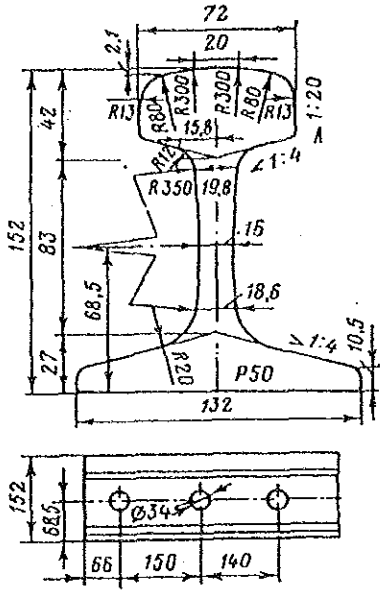
a- width of embarkment

Double track

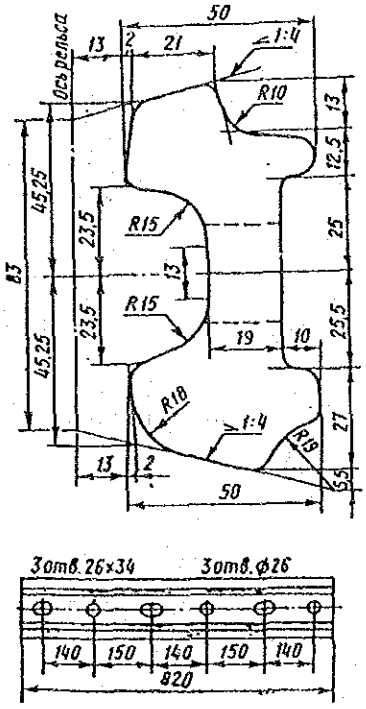


Appendix 4-3-9 Track Materials

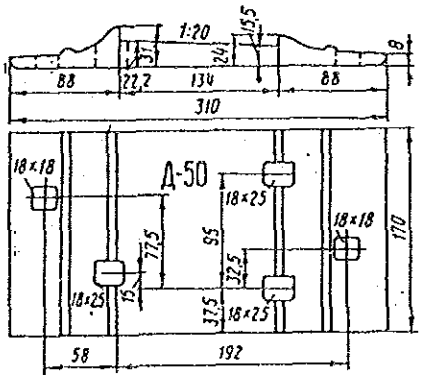
P 50 Rail



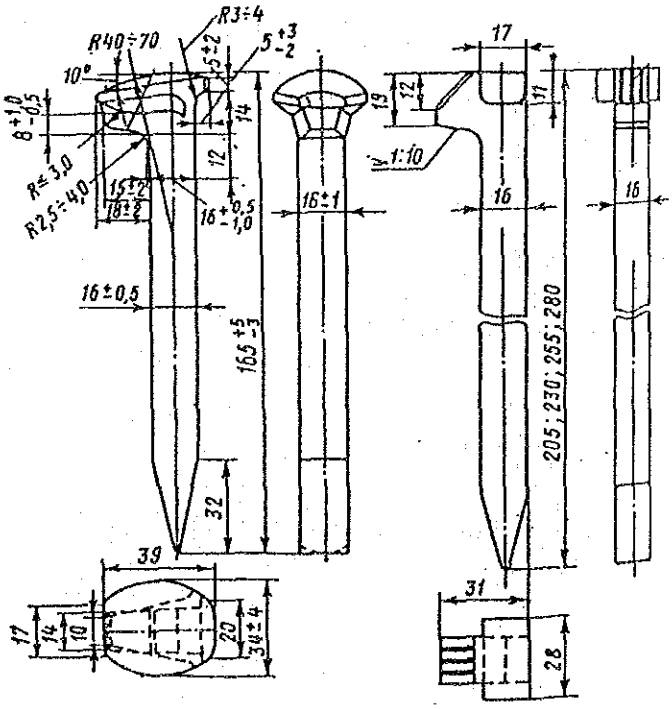
Rail joint plat



Tie-plate

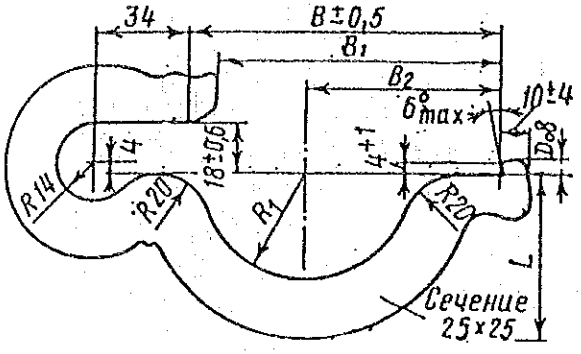


Spike



Appendix 4-3-10 Track Materials

Anti-creeper

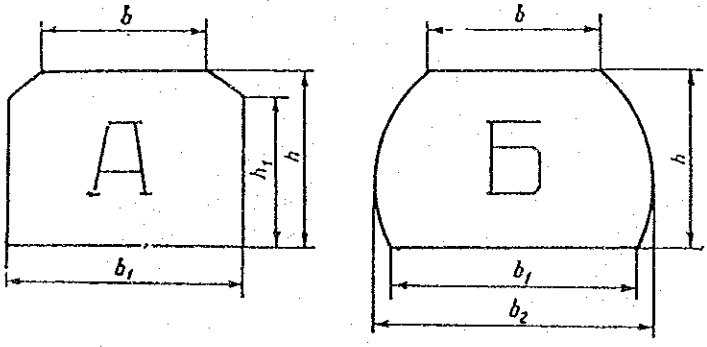


Size of Anti-creeper

(Unit: mm)

B	B1	B2	L	R1
92	82	59	53	30

Wooden sleeper



Size of Wooden Sleeper

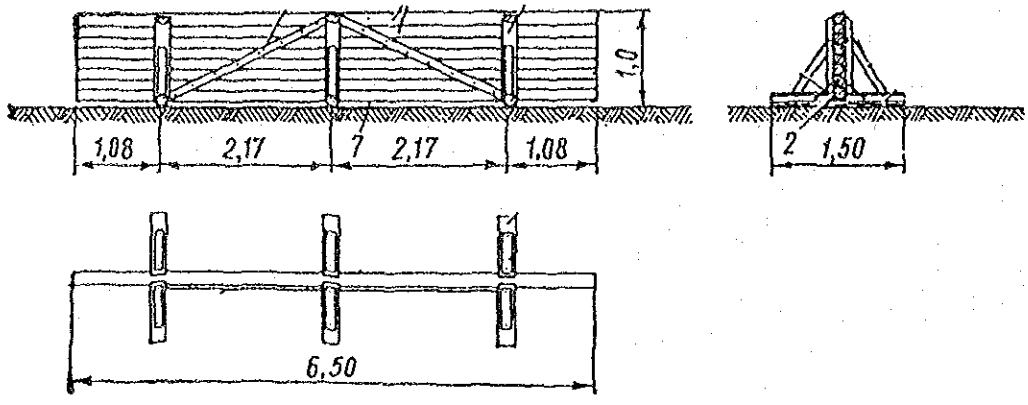
(Unit: mm)

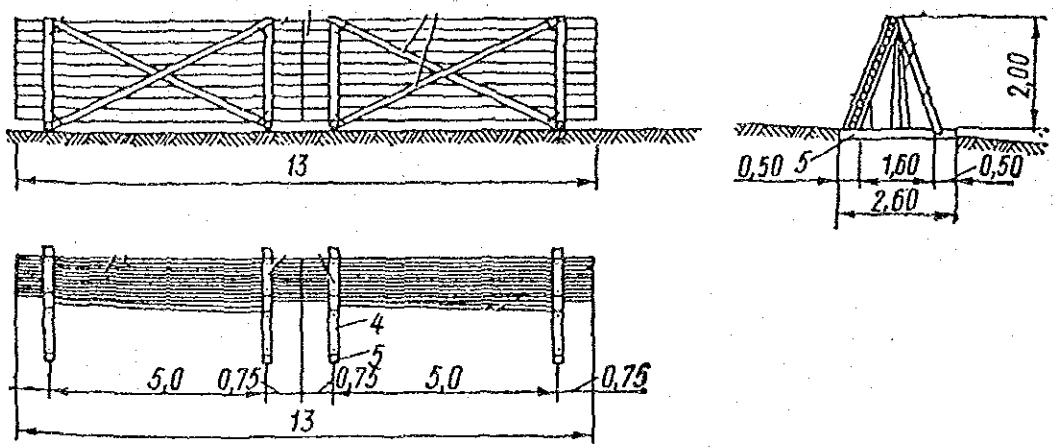
Type	h	b	b_1	b_2	h_1	Remarks
I	180	165	250	280	150	1,520mm1=275
II	160	160	230	260	130	1,435mm1=270
III	150	150	230	250	105	

(Unit: sleepers/km)

Track	1,520mm		1,435mm	
Main	Straight or R≧1200	1600	Straight or curved	1840
	R<1200	1850		
Receive-sending		1600		1600
Others		1440		1440

Appendix 4-3-11 Anti-sand and Snow Wall





4-4 Cargo Transshipment Equipment

4-4-1 Basic Policy

Planning the cargo transshipment facilities is made according to the cargo transportation plan (reference "4-2").

(1) Zamyn-Uud Station has a character as a transshipment station of cargo from Chinese to Mongolian freight cars. (It is unusual that the cargo unloaded from freight cars are temporarily stored and carried out of the station by trucks.)
Accordingly, the method of directly transferring the cargo from Chinese to Mongolian freight cars is considered as a principle.

(2) Zamyn-Uud Station is located at the border of Mongolia and is far from the major cities, and when the living environment is considered, it is desirable that the transshipment is efficiently made by as small a number of personnel as practicable.
Thus, for the cargo transshipment machines, those requiring as less manpower as possible, allowing efficient transshipment and permitting maintenance with ease, are generally considered.

(3) Presently, the cargo is transported from China to Mongolia in 20-feet containers of ISO specification, but as it is expectable that the cargo will be transported in 40-feet containers in future, the planning is made accordingly.
In planning, the prospected forms of package, freight cars used for transshipment, character of Zamyn-Uud Station and features of cargo handling machines are taken into consideration, and the study is made according to the following procedures.

1) Projection of the packing forms (reference "4-4-2")
Cargos that are likely to come from China to Mongol are considered.
2) Structures of freight cars (reference "4-4-3")
Examining the structures of freight cars used for transshipment, they are taken as data for examination of the cargo handling machines.
3) Character of Zamyn-Uud Station (reference "4-4-4")
The character of Zamyn-Uud Station as a transshipment station is taken into consideration.
4) Selection of cargo handling machines (reference "4-4-5)
With the packing forms, structures of freight cars and character of Zamyn-Uud Station taken into consideration, the cargo handling machines suitable for transshipment are examined.
5) Required number of cargo handling machines (reference "4-4-6")
The required number of cargo handling machines is examined according to the transportation plan.
6) Summary (reference "4-4-7")

4-4-2 Projection of the Packing Forms

Packing forms vary greatly depending on the tyc, shape and property of the cargo.

And, it is considered that the proportion of containers will gradually increase.

However, when the increasing flow of commodities from China to Mongolia is considered, it is not expectable that the standardized forms of packing will soon be realized, and so it is necessary to consider the transshipment of cargos in multifarious and diversified forms.

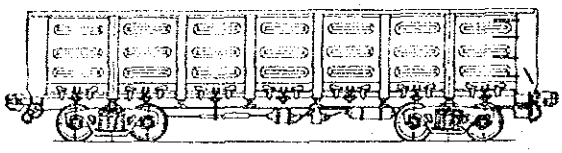
The generally considered packing forms are as follows.

(Note) Photos show the forms of cargos handled in Ulaan-Baatar and do not always show those coming from China.

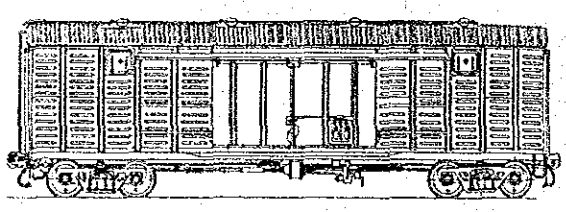
(1) General Cargo

The general cargo is also called the dry cargo and is comprised of a variety of commodities. These commodities are sundries, canned foods, textile products, housing articles, home electric appliances and machines, and they are normally packed.

[Freight Cars Used]



Open Wagon



Covered Wagon

1) Case Goods

General terms given to case goods, including vegetables, green fruits, eggs, meat, household articles, home electric appliances, clothing, machines, glass products, ceramics, bottled articles, toys and other sundry goods.

The packing forms are box, cartoon, chest, skelton case and crate.

Cartons Containing Soap

Creates Containing Glass

2) Bag Goods

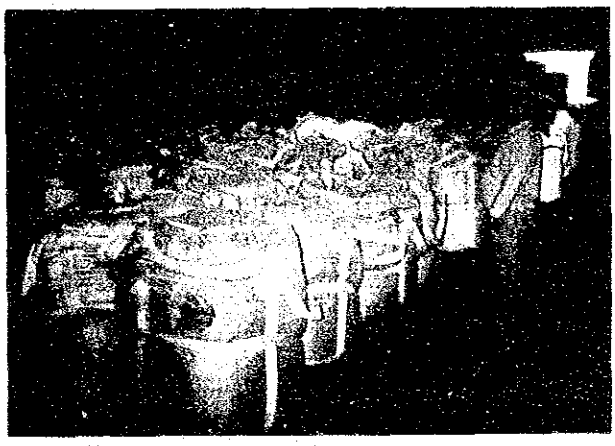
General terms given to bag goods, including grains, sugar, wheat flour, fertilizers, cement and ores.

Paper bag, gunny bag, jute bag, sack and straw bag are available in the forms of flat bag, square bag, etc.

Among the bag goods coming from China, the heaviest one is the fluorite, 800kg per bag.

Reference: Packing Form for Export of Refined Copper Ore

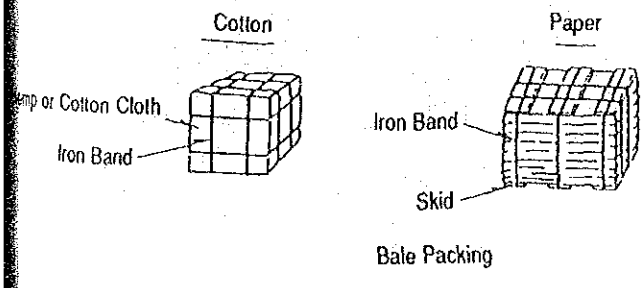
Contained in Iron Pots and Transported Via Siberian Railway



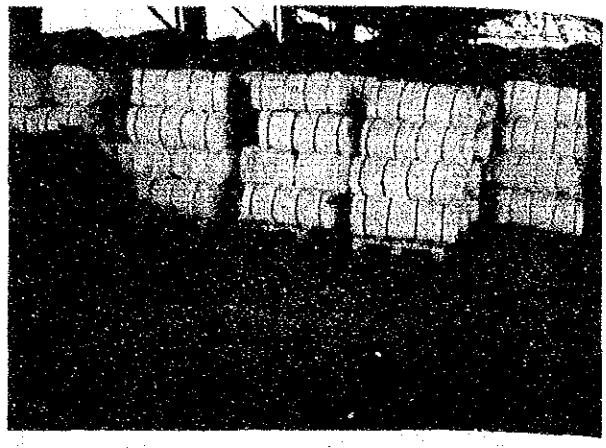
Contained in Bags, Transported Via Erdenet and Zamyn Ude, Transshipped at Elenhot in China, and Exported from Tientsin Port to Japan

3) Bale Goods

Goods compressed and wrapped in hemp cloth, cotton cloth or straw mat and bundled by rope or iron band, including cotton, wool and paper.

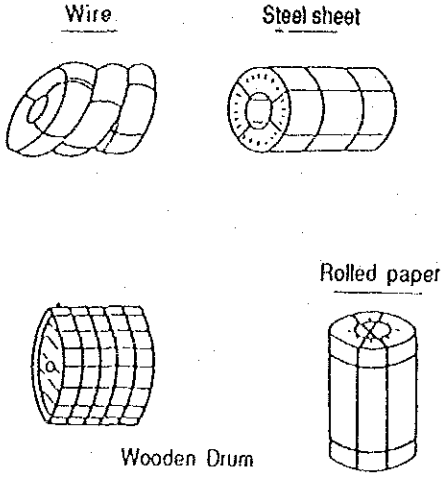


Bale Packing

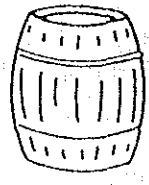


4) Bundle Goods

General terms given to bundled goods, including cotton, wire, electrical wire, rolled paper and carpet.



Tyres Unloaded from Freight Car



Keg

5) Barrel Goods

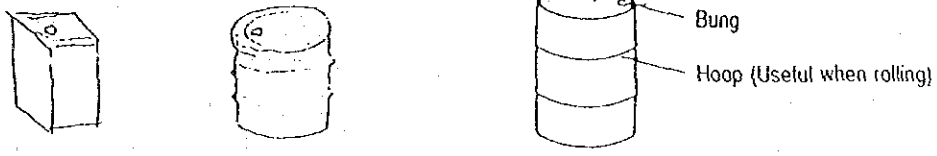
Barreled goods, including liquor, beer, dyestuff, chemicals, pegs, bolts, nuts, etc.

6) Can

In general, a vessel manufactured from iron, but including a can having a metal bonded to cardboard or plastics and a can made of plastics.

Paint, fat and oil, petroleum products, foods, chemicals, alcoholic liquors, animal and vegetable oils, etc.

Comprising round can, square can and elliptical can.



(2) Containerized Cargo

Cargo packed in container and loaded and unloaded by container handling equipment.

Sundry goods, textile products, machines, frozen cargo, bulk cargo, etc.

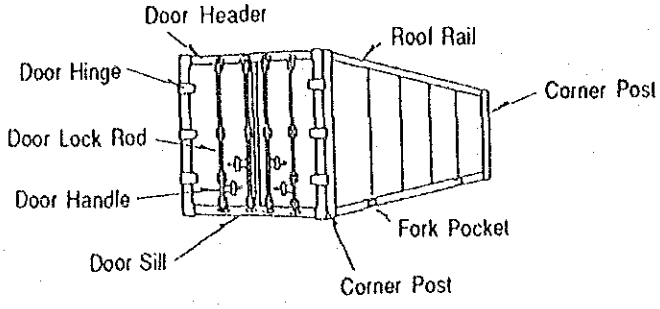
Containers include various types depending on the use and size, but the containers of 20 feet and 40-feet containers of ISO specifications are typically used internationally.

Presently, 20-feet containers are used for shipment from China to Mongolia, but it will be necessary to consider that they will be changed sooner or later to 40-feet containers.

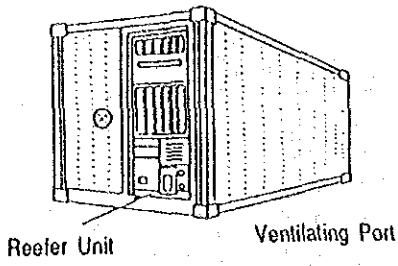
[Freight Cars Used]

Container　　Open Wagon

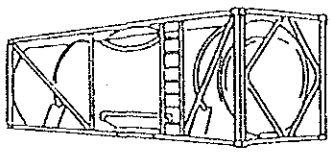
(Note) Containers are usually transported by container carrying cars, but in the case of the Mongolian Railway, the container carrying cars are in shortage, and so the containers are often loaded on open wagons.



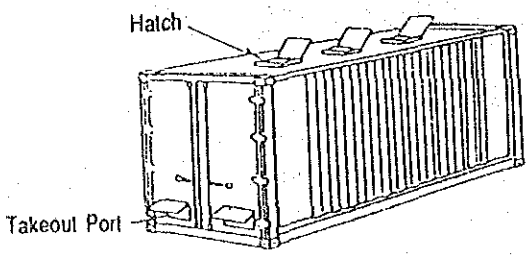
Dry Container



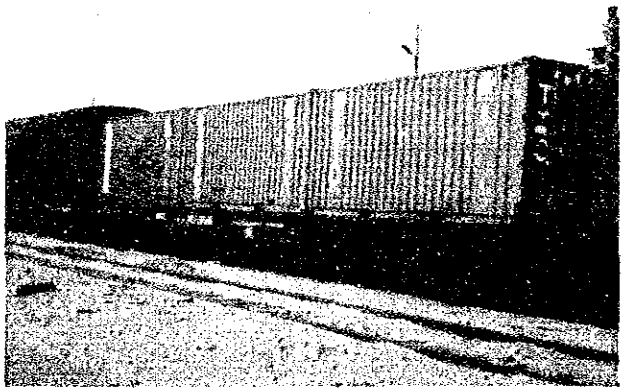
Freeze Container



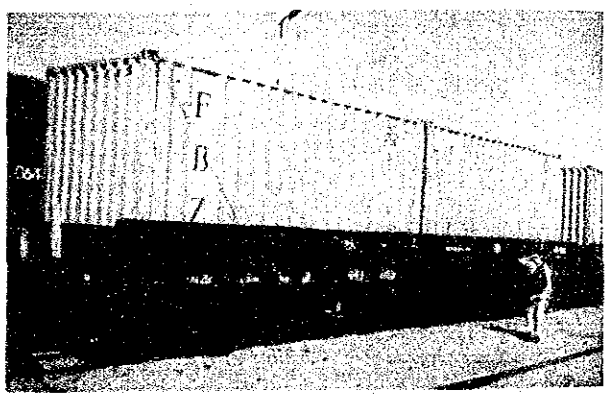
Tank Container



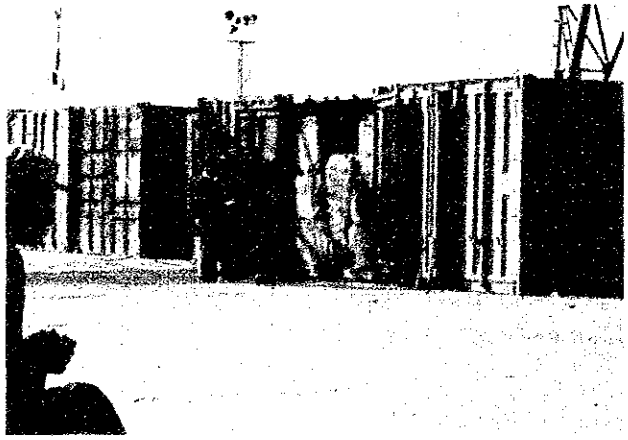
Bulk Container



Containers Properly Loaded on Freight Car



Container Loaded on Open Wagon and Fastened with Wire



Bale Goods Loaded in Container

Standard Sizes of Container

ISO Containers

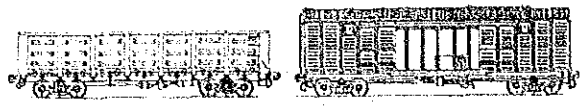
Types	Outer Dimensions (mm)			Maximum Overall Weight (kg)
	Length	Width	Height	
1AA	12,192	2,438	2,591	30,480
1A	"	"	2,438	"
1AX	"	"	<2,438	"
1BB	9,125	2,438	2,591	25,400
1B	"	"	2,438	"
1BX	"	"	<2,438	"
1CC	6,058	2,438	2,591	24,000
1C	"	"	2,438	"
1CX	"	"	<2,438	"
1D	2,991	2,438	2,438	10,160
1DX	"	"	<2,438	"

Remarks: JIS Specification (JIS Z1614) concerning the international large containers specifies two types, 1AA and 1C, among the foregoing.

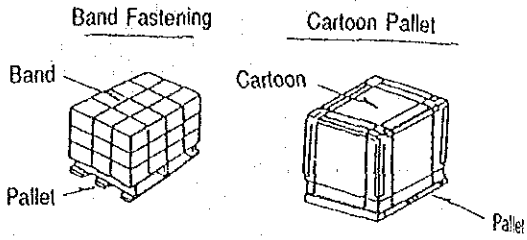
(3) Palletized Cargo

Cargo loaded and unloaded on pallets. When the commodities placed on a pallet are fastened with wire or band into a single unit, they can be directly loaded and unloaded. At present, loading with pallets onto a freight car is not in practice, but in future it will be considered.

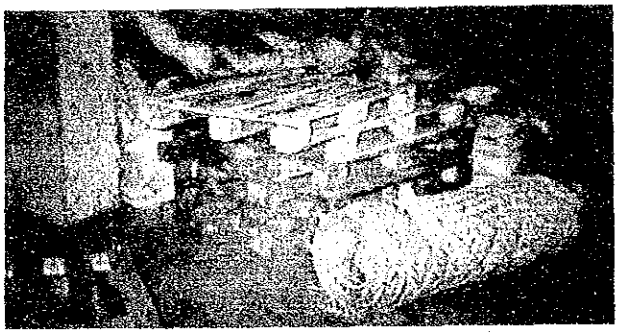
[Freight Cars Used]



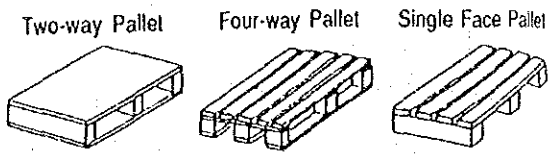
Open Wagon Covered Wagon



Various Pallet Packings



Pallets Used in Warehouse



Reference: Various Pallets

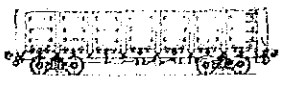
(4) Bulk Cargo

Cargo directly loaded in the state of bulk.

Grains of rice, barley, soybean, etc., fuels, raw materials and chemical fertilizers such as coal, ore and industrial salt, and lumber and material wood.

However, there is no bulk cargo of coal or lumber from China to Mongolia presently. Wheat flour comes in bags from China to Mongolia.

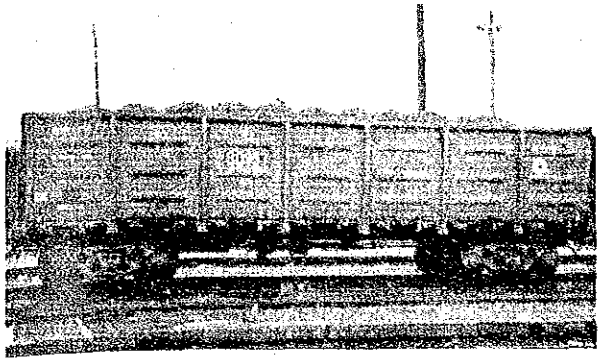
[Freight Cars Used]



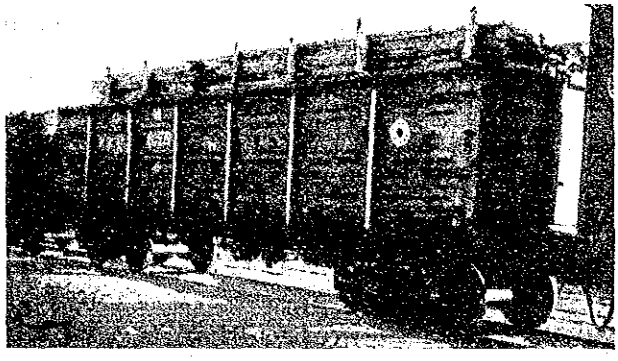
Open Wagon

Covered Wagon

Hopper Car



Coal in Domestic Transport



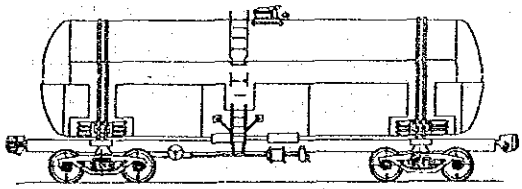
Lumber from Former Soviet Union

(5) Liquid Cargo in Bulk

Liquid cargos of crude oil, heavy oil, lube oil, kerosene, gasoline, naphtha, petrochemical products, animal; and vegetable oils, etc.

For the canned goods, reference "(1)-6)."

[Freight Car Used]



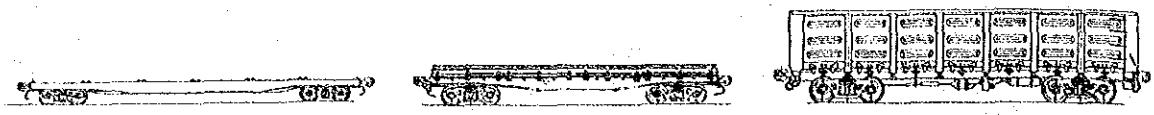
Note: Containers may be used in future. In such case, the cargo will be handled as containerized cargo.

(6) Heavy Cargo, and Bulky Cargo and Lengthy Cargo

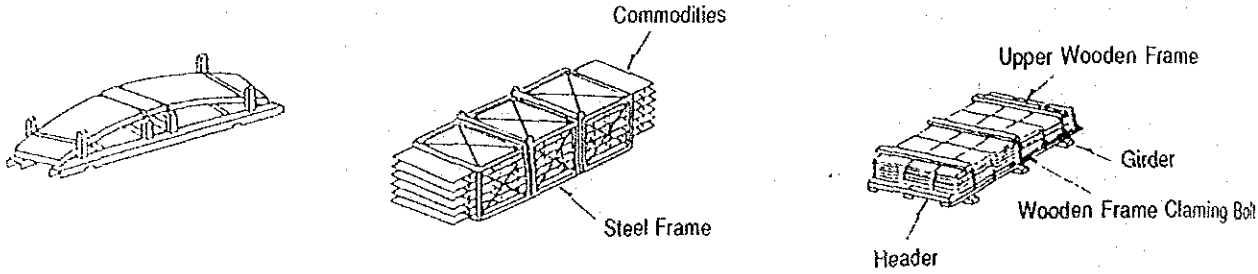
Large and heavy cargo or length cargo such as motor cars, plant towers and tanks and construction steels.

In the future, it is expected that the construction, civil engineering and other large machines are disassembled, as required, then loaded on freight cars and transported from China to Mongolia.

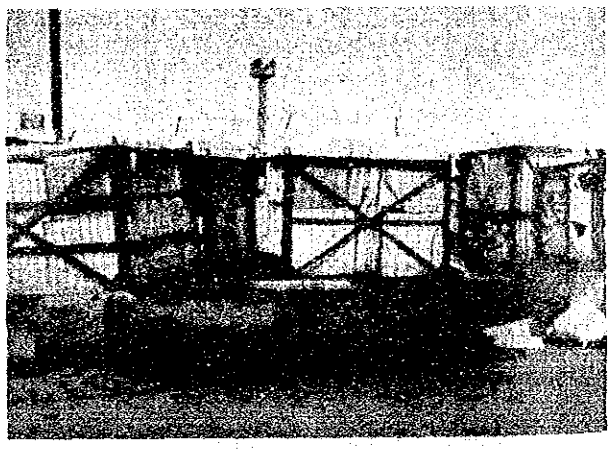
[Freight Cars Used]



[Packing Forms]



Manufacturing Machines from Former Soviet Union



Construction Materials

4-4-3 Freight Car Structures

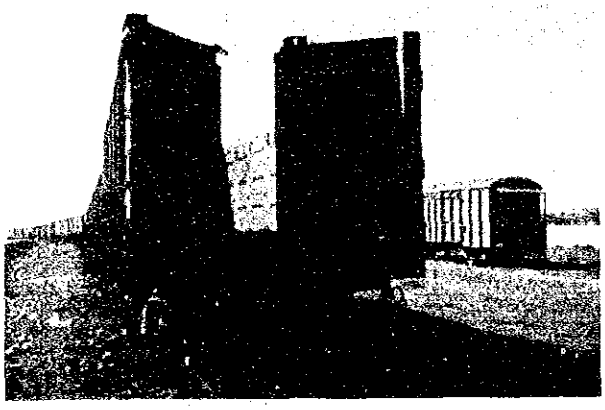
When the transshipment equipment is installed in Zamyn-Uud Station, it is necessary for examining the cargo handling machines to know the structures of as well as the packing forms of Chinese and Mongolian freight cars (including those owned by the former Soviet Union) used for transshipment.

Freight cars used at Zamyn-Uud are shown in Figure 4-4-1, and those of the Mongolian Railway are shown in Figure 4-4-2.

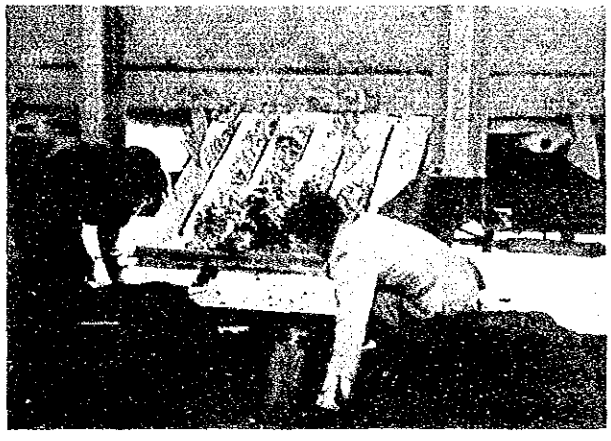
As the result of the investigation, the following points are particularly noted.

(1) Container cars are not available in a sufficient number presently, and so containers are often loaded on open wagons.

(2) The greater part of the open wagons are so structurally designed as to carry the granular cargo such as coal (with the side framing fixed and the bottom cover adapted to open).
Therefore, for loading and unloading of cargos on open wagons, there will be required the cranes and other cargo handling machines which are capable of moving the cargo up and down vertically. From the structure of the freight car, it is difficult to horizontally load the cargo onto or pull it out of the freight car by the forklift.

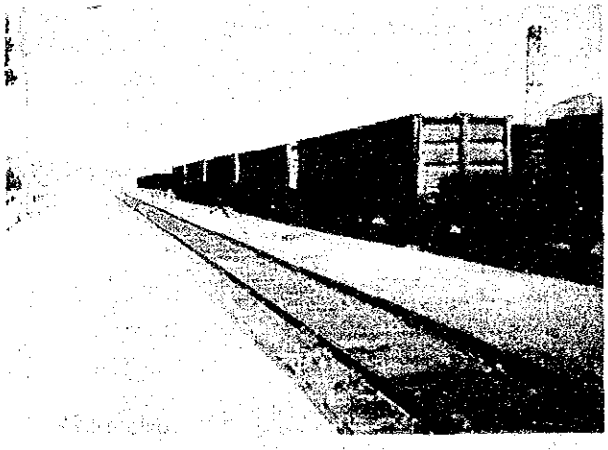


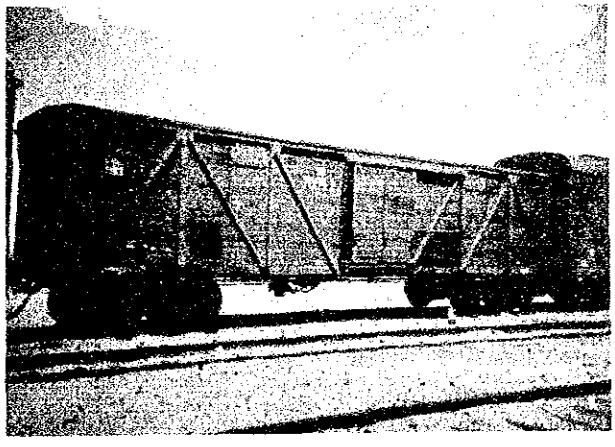
Open Wagon
(End Plate Opened)



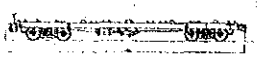
Open Wagon
(Bottom Cover Opened)

(3) It is desirable to increase the freight cars which are adapted for the packing forms, but this will not be resolved soon. Therefore, the machines required for cargo loading and unloading should, for the time being, be those having the present freight car structures taken into account.



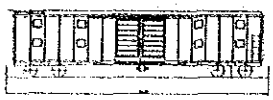


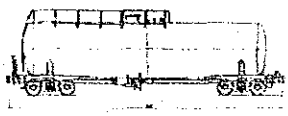
[Chinese Freight Cars] Gauge 1,435mm

NJ4A  Unladen : 14.5t
Laden: 30(40)t

C62A  Unladen: 22.3t
Laden: 60t

PD5  Unladen: 17.3t
Laden: 50t

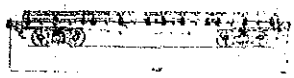
P62  Unladen: 24t
Laden: 60t

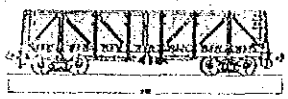
G19  Unladen: 21t
Laden: 60t

[Mongolian Freight Cars] Gauge 1,520mm

Freight Cars Owned by Former Soviet Union

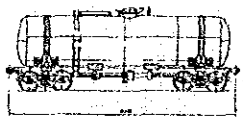
13-470  Unladen: 22t
Laden: 60t

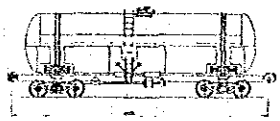
13-401  Unladen: 20.9t
Laden: 70t

12-515  Unladen: 21.8
Laden: 69t

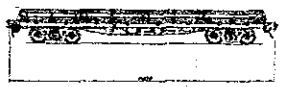
12-119  Unladen: 22.46t
Laden: 69t

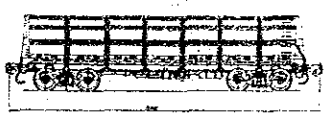
11-217  Unladen: 24t
Laden: 68t

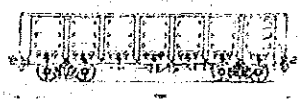
15-869  Unladen: 25.3t
Laden: 62t

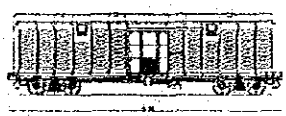
15-1566  Unladen: 24.23t
Laden: 63.5t

Freight Cars Owned by Mongolia

13-4012  Unladen: 21.4t
Laden: 71t

12-726  Unladen: 22±0.66t
Laden: 69t

12-119  Unladen: 22.46t
Laden: 6t

11-K001  Unladen: 22.88t
Laden: 68t

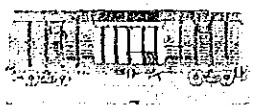
11-217  Unladen: 24t
Laden: 68t

Fig. 4-4-1 Freight Cars Used at Zamyn-Uud

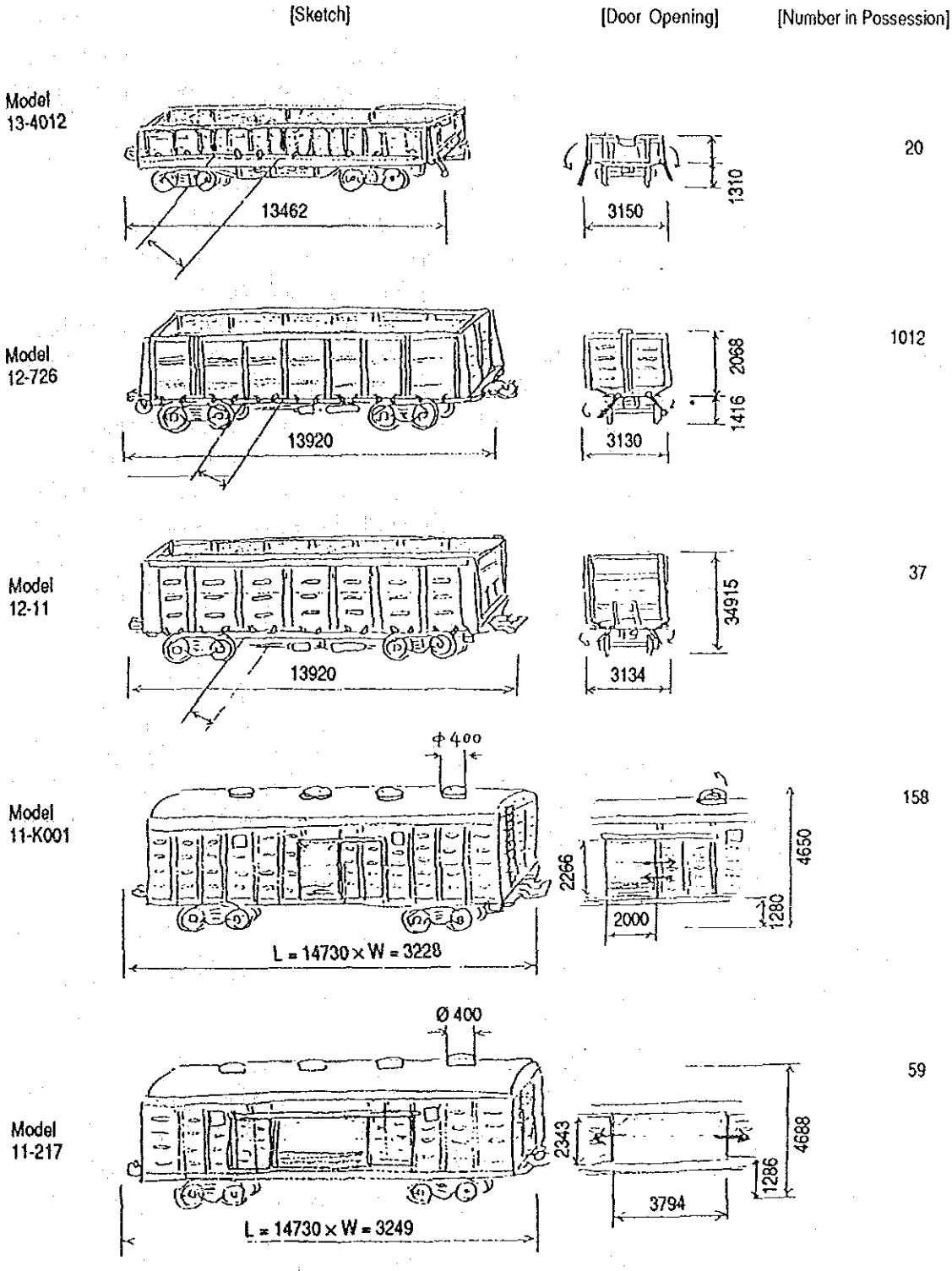


Fig. 4-4-2 Freight Cars of Mongolian Railway

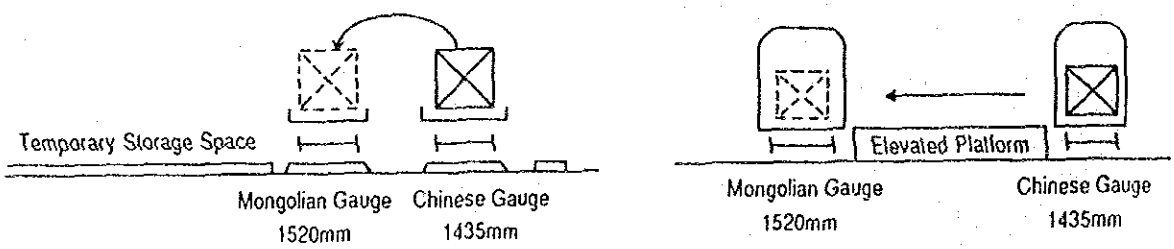
4-4-4 Character of Zamyn-Uud Station

Zamyn-Uud Station is a border station to China and has no industrial or agricultural activities carried out in the vicinity. The station has a role of transit station of passengers and freights between Mongolia and China, and its character is different from that of an ordinary freight station.

In the ordinary railway stations, the cargo handling is generally freight car - truck and freight car - cargo yard, and the transshipment between the freight cars is not undertaken, as a rule. Cargo handling at the Station is mainly transshipment between the freight cars, and unloading of the cargo to the cargo yard is limited only when the Chinese and Mongolian freight cars are not matching properly.
(If the railway gauges are the same, the freight cars will pass through the Station.)

Almost all cargos transported from China to the Station will have to be transshipped to the Mongolian freight cars and carried into Mongolia as well. Little cargo is unloaded at the Station, stored temporarily, then carried to the outside of the Station by trucks.
Basically, therefore, it is important to consider direct transshipment of cargo from Chinese to Mongolian freight cars.

Accordingly, the containers and cargos on open wagons are adequately transshipped with the tracks of the Chinese gage and the tracks of the Mongolian gauge disposed alongside to each other, and for the cargos on covered wagons, the transshipment is adequately carried out with the respective tracks arranged on each side of an elevated platform.



4-4-5 Selection of Cargo Handling Machines

(1) Types of Cargo Handling Machines

There are a variety of types available for the machines used for cargo handling (loading and unloading), and the machines to be used are greatly varying depending on the place of handling, form (property and unit weight) of the cargo and the quantity to be handled.

Of the cargos, those that are handled in the greatest quantity are shipped cargos, and the handling quantity is 1,000t at the least to as much as 100,000t

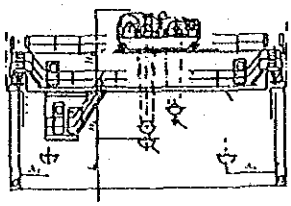
To handle such cargos, the specially designed machines are required, including the unloader and loader handling the bulk cargos in a great quantity, stacker and reclaimer in the storage yard, gantry crane and jib crane for handling steels and sundry goods, and container crane handling containers.

Also, a number of cargo handling machines are used for storage and discharge of products running along the production line in manufacturing plants. But, the products include a heavy one such as coil of steel sheet having a unit weight close to 20t to a readily handled one by manpower with a weight of several kilograms, and so the handling machines vary accordingly.

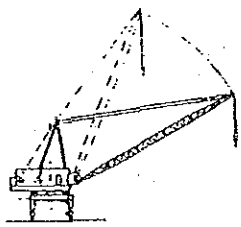
For carriage in a plant, an overhead traveling crane is mainly used, and for carriage between the plants or from a plant to a product storage space, the forklift, carrier car and truck are used.
The machines used in the product storage space and warehouse are the gantry crane, overhead traveling crane and forklift and other small carriers.
In the container yard, the containers are generally large in size as well as weight, and so the cargo handing machines are installed outdoors, and they include the large gantry crane, reach/stacker crane, forklift, straddle carrier and trailer.
Then, for the cargo handling machines, it is necessary to consider an optimum suite for each case according to the quality and quantity of the work and the available space.
The cargo handling machines to be used are classified largely into the cranes handling large and heavy cargos, forklifts and other industrial carriers handling relatively lightweight and small cargos, and conveyors including the loader for successively handling mainly bulk cargos.
Cargo handling at the railway stations involves a difficult aspect for the sake of efficiency of the work in that various kinds of cargos have to be handled and that the available space is limited in the freight car.
Assuming the transshipment of the cargos in the forms described in "4-4-2 Projection of Packing Forms," the cargo handling machines are chosen as shown below.

1) Cranes - Heavy and containerized cargo handling

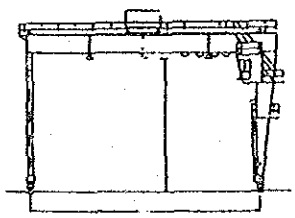
a. Overhead Travelling Crane

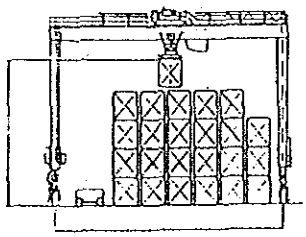


b. Jib Crane

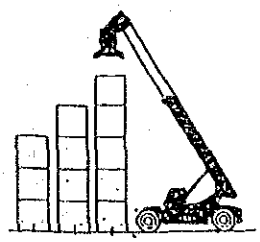


c. Gantry Crane





2) Reach Stacker Crane



3) Truck Crane

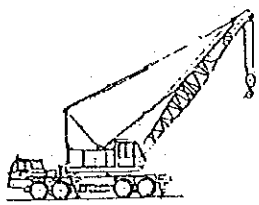
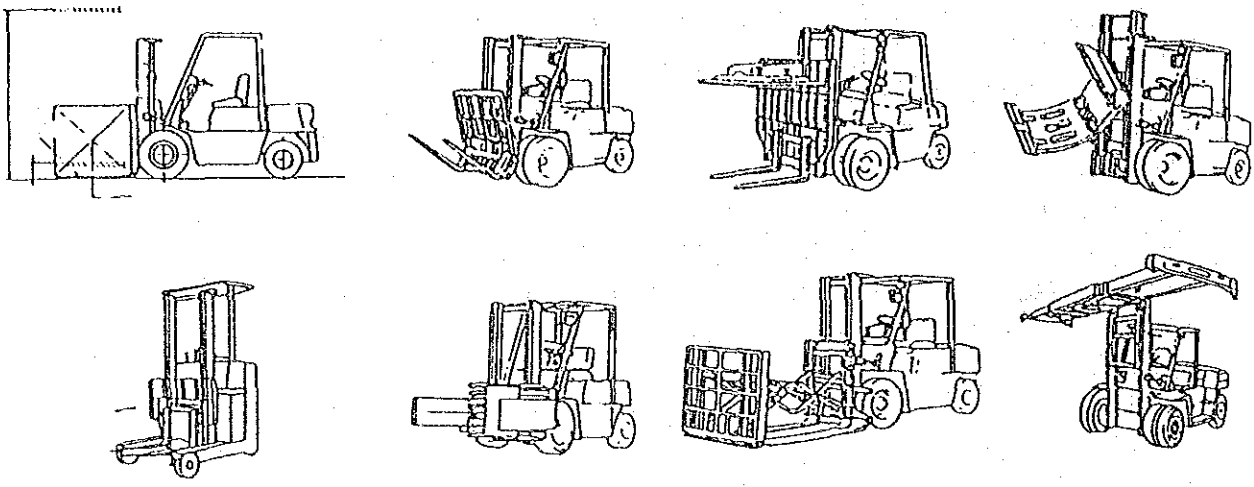


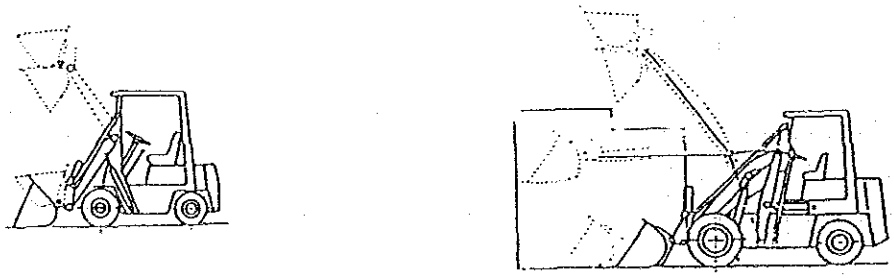
Fig. 4-4-3 Cargo Handling Machines

Note: The following diagrams are for the sake of example, and each machine is comprised of various types.

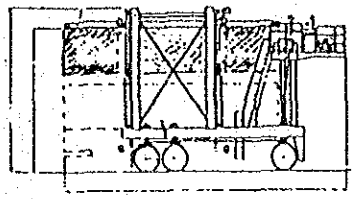
4) Forklift Truck



5) Shovel Loader

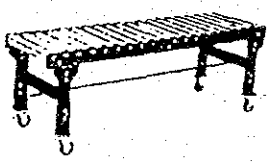


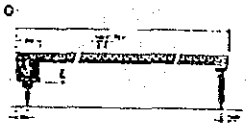
6) Straddle Carrier

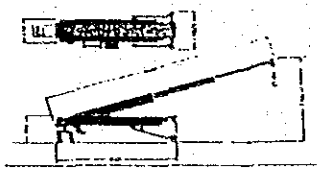


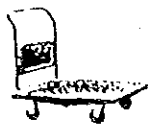
Designed to move the container placed on the ground to any other place and not adapted to load or unload the container on the freight car.

7) Conveyor, etc. - Handling of case and bag goods



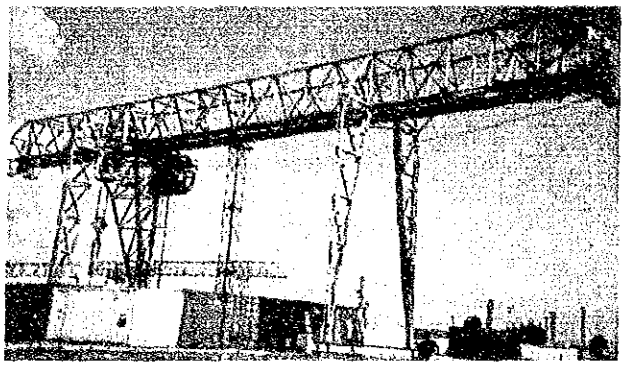


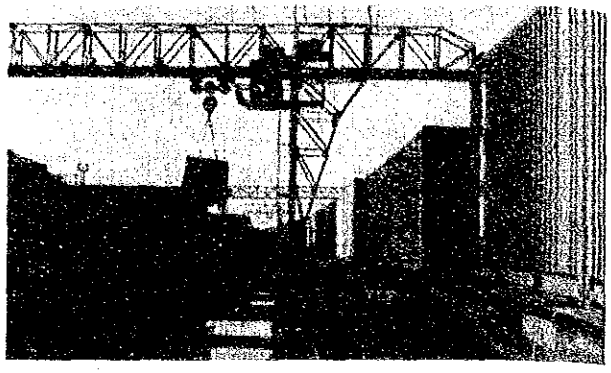




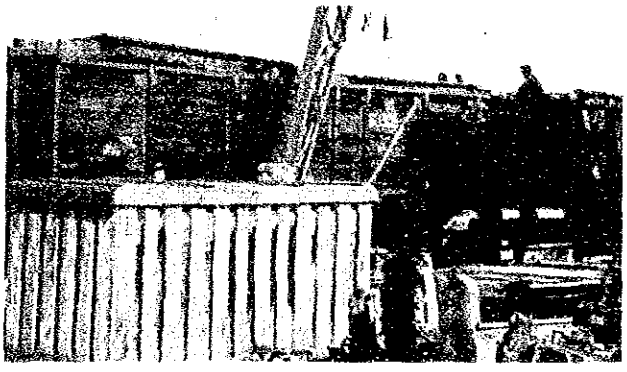
[Reference] Cargo Handling Machines used at Ulan Bator

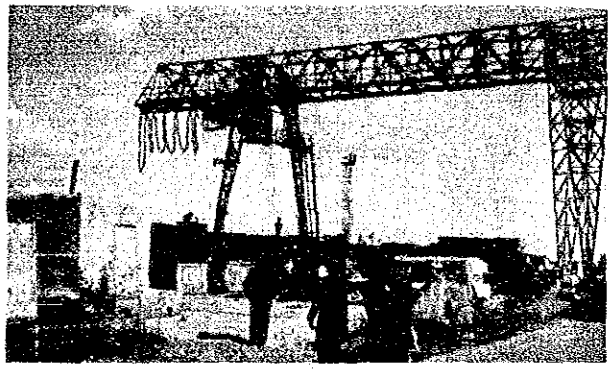
a. Crane at Container Terminal





b. Cranes at Terminal at Heavy, Lengthy and Bulky Cargos

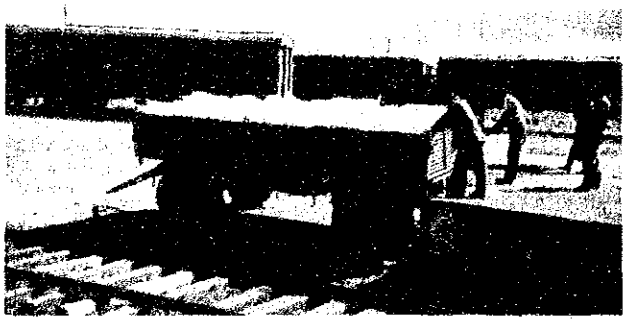


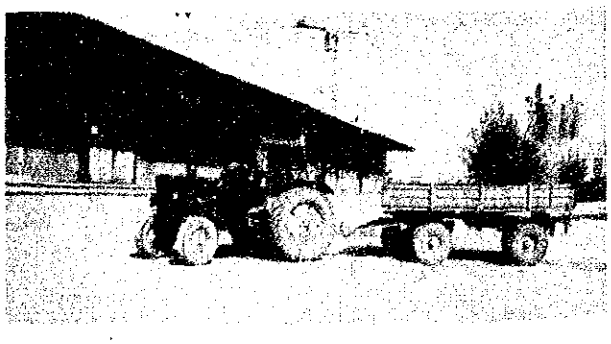


c. Carriage by Forklift

d. Carriage by Handcart

e. Carriage by Truck





(2) Selection of Cargo Handling Machines

Cargo handling at Zamyn-Uud Station is to transfer the cargo from the Chinese to Mongolian freight cars, and for the cargo handling machines, it is necessary to comprehensively consider the packing forms of the cargos and structures of the freight cars and also the following factors:

- Safety -

  Machine allowing operation with ease and scarcely producing a contact, damage or any other failure with little disaster caused to the personnel including workers in cargo handling work (good machine in safety and operability);

- Efficiency -

  Machine of highest productivity in consideration of the purpose of transshipment, forms and quantities of the cargos to be handled, and available space; and

- Miscellaneous -

  Machine ease of maintenance and ease of adaptation to anomalous condition.

From the forms of the cargos and structures of the freight cars, the transshipment is classified largely into the following three.

- Transshipment of containers loaded on container cars.

  Note: Container cars are in shortage, and so containers are often loaded on open wagons.

- Heavy, lengthy and bulky cargos loaded on open wagons.
- Case, bag and can goods of relatively small volume and weight loaded on covered wagons.

For the cargo handling works of the foregoing three types of cargos, the cargo handling machines are examined as below.

1) Transshipment of containers loaded on container cars

As the machines suitable for container transshipment, the gantry crane, reach/stacker crane and forklift are considered, and their features are as follows.

Machines	Features	
Gantry crane	Operability	Good visibility from the operator for ease of the spreader adjustment and stability in movement of the cargo
	Efficiency	Capable of covering both Mongolian and Chinese tracks to reduce the distance of carriage and thus ensuring efficient transshipment.
	Miscellaneous	Used extensively
Reach stacker crane	Operability	Good visibility over the forklift, allowing spreader adjustment with ease
	Efficiency	Capable of extending the boom and thus handling a cargo located apart as compared with the forklift. Required to secure a traveling path for 40-feet (about 12m) container in the yard. Having mobility capable of carrying a container to a far apart place or loading or unloading a container with the direction changed.
	Miscellaneous	Not much used in Japan and not produced in Japan, but through development in these 10 years, manufactured in foreign countries.
Forklift	Safety	Visibility is not so good as that of gantry crane or reach stacker crane
	Efficiency	Having mobility capable of carrying a container to a far apart place or loading or unloading a container with the direction changed. Required to secure a traveling path for 40-feet (about 12m) container in the yard. But, the forklift is unable to handle containers except one immediately before.
	Miscellaneous	Used extensively for small containers but not much for 40-feet containers (particularly rarely for loaded containers). From the structure of the spreader elevating device, possibly not applicable to containers on open wagons having high side framing.

Note: Safety and efficiency described above are general in nature and are subject to change depending on the skill of the machine operator.

From the foregoing, the forklift is structurally hardly applicable to loading of containers onto or unloading from open wagons having high side framing, and when carrying a large container, it lacks in stability, as compared with the other types of machines, in that the center of gravity of the container is biased to the forward part of the machine.

Unlike the forklift, the reach stacker crane is capable of handling a container located more or less apart, and at the same time, it is adapted to freely move in the yard and thus freely choose the place to set the container like the forklift, and so it has a mobility.

But, when it is to carry a container of 12m in length and 30ton in weight, a running path will have to be secured and paved.

The cargo handling at Zamyn-Uud Station is to transfer the cargo between the freight cars, and so when the gantry crane is used, it is possible to adjacently arrange the Mongolian and Chinese tracks to each other for convenience of the transshipment. Also, in the case of mismatching of the freight cars, the yard is usable as a container yard, thus providing highly stable and efficient operation.

In view of the foregoing, the gantry crane or reach stacker crane is considered to be suitable for transshipment of containers at Zamyn-Uud Station when the work efficiency and machine handling are generally considered.

2) Transshipment of cargos loaded on open wagons

Cargos carried on open wagons are comprised of those cargos which can be exposed to rain such as machine and other heavy articles, steels of various shapes and lumber, ore and other bulk cargos and also cargos which are difficult to place in containers or covered wagons.

As the handling machines, the gantry crane, truck crane and forklift may be considered.

For the heavy articles such as machines and heavy or lengthy articles such as steels, the work is most stably carried out when they are lifted and suspended by the gantry crane with slings used.

They may be handled by the truck crane, but the transshipment between the freight cars involves the rotary operation of the crane, and so the work stability is not always high. Further, the truck crane accompanies the work of stretching outriggers for preventing overturn of the crane in lifting the cargo, and when it is required to move for a long distance with the cargo suspended by wire, the cargo may have the packing broken or come into contact with any other article, and so care must be exercised.

There may also be considered the method of unloading from the side of the freight car with the forklift used. But, for unloading a heavy article loaded at the central part of the freight car, a forklift having a large capacity and a great reach is required, and this is not practical. Further, the freight cars of Mongolia have generally the side framing fixed, and so the forklift is hardly applicable.

In such a case, the gantry crane is considered to be suitable, but the truck crane is usable as well.

3) Transshipment of cargos loaded on covered wagons

Cargos loaded on covered wagons require man-power for handling, and so they are generally those of relatively small volume and weight or those which should not be exposed to rain. Cased or bagged sundry goods, foods, fertilizers and clothes are typical.

The covered wagons have generally a small door opening, and the work through such small opening is usually inefficient. To enhance the efficiency, it is necessary to provide an elevated

platform between the freight cars requiring transshipment and use a small forklift, conveyor and handcart as much as practicable and reduce the manual work.

Also, in preparation for mismatching of freight cars, it will be required to provide a storage place or storage shed on the platform against storm.

Further, for improvement of the cargo handling work, it will be necessary to positively consider the use of pallets in combination with the forklift.

4-4-6 Required Number of Cargo Handling Machines

(1) From the transportation plan, the required number of freight cars for transshipment per day and the number of containers are as follows (for 2 trains).

Container:	105 containers/day
Open wagons:	13 cars/day
Covered wagons:	12 cars/day

(2) As the result of investigation of the present status in Mongolia, the required time for transshipment is, as an average, as follows.

Container:	20~30mins/car	10ton or 20ton crane wired Two~three 20-feet containers per car
Open wagon:	30~40mins/car	10ton crane wired
Covered wagon:	3~5hrs/car	Manual work of 3 men
	1.5hrs/car	Manual work of 9 men
	1hr/car	Two 2.5ton forklifts

In consideration of the present condition stated above and the points of difference in transshipment at Zamyn-Uud, the time required for direct transshipment of cargo from Chinese to Mongolian freight cars is estimated as below.

Container: 4~5mins/container

At Zamyn-Uud, containers of ISO specification are suspended by special lifting tools, and so no wiring is required.

Open wagon: 30~40mins/car

With the crane used, there is not much difference between the method currently employed and that at Zamyn-Uud.

Covered wagon: 2.5hrs/car

Presently, only the unloading work is undertaken, but at Zamyn-Uud, loading work is required.

A set of 1 forklift, 1 conveyor and 2 workers is assigned per car.

(3) From the number of cars requiring transshipment, number of container and required time for transshipment estimated as above, the total work hours per day and the number of required machines are estimated as below.

Cars	(a) Number of cars or containers per day	Required time for transshipment		(d) Workable hours	(c)=(c)/(d) Number of machines
		(b) 1 Car or 1 container	(c)=(a)×(b) Per day		
Container	105	4~5mins	525mins		0.8 unit
Open	13	30~40mins	520mins	16×0.7=11.2hrs	0.8 unit
Covered	12	2.5hrs	30hrs	(672mins)	2.7sets

Note: For the workable hours (d), preparation, rest and standby during the work are taken into account, and its 70% is taken as the net working hours.

The foregoing is the result of calculation in average, but it is required to consider the following:

- Changing composition of container, open and covered freight cars from train to train;
- Changing transshipment time with the form and weight of cargo; and
- Number of reserve machines against failure or inspection of the machines.

When these are taken into consideration, the number of the machines to be installed is as given below.

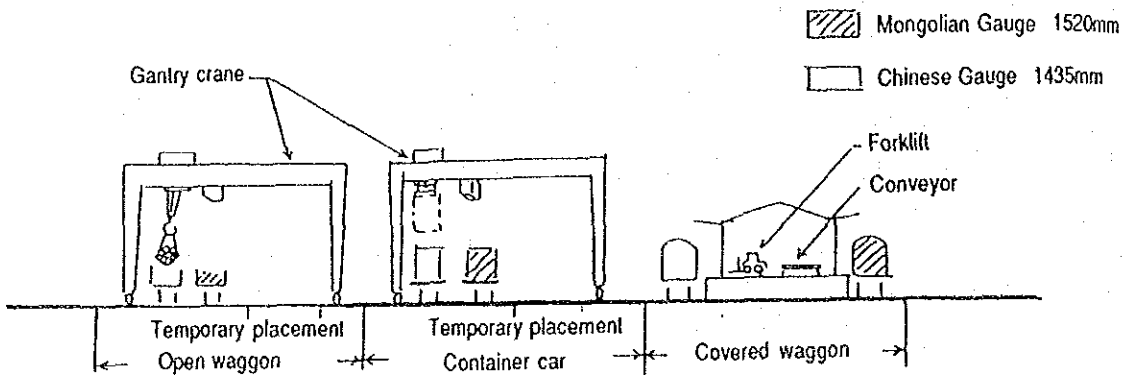
Cars	Number of machines installed			
	Plan 1		Plan 2	
Covered	Small forklift Conveyor	4 units 4 units		
Container	Gantry crane	2 units	Reach stacker crane	2 units
Open	Gantry crane	1 unit	Truck crane	1 unit

4-4-7 Summary

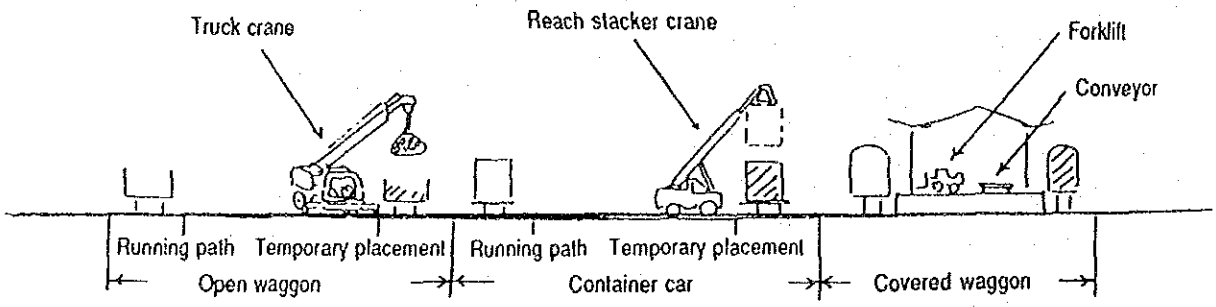
Summing up the result of the foregoing study with various conditions taken into account, the plans shown below are conceivable.

In the drawings, transshipment of the open freight cars is apt to produce dust, and so the place of transshipment of the open freight cars is provided at the end.

Plan 1



Plan 2



4-5 Signal, Telecommunication and Power Supply

4-5-1 Signal Equipment Plan

(1) Signal Equipment

We plan to install home signals, departure signals and shunting signals based on the track layout plan. In case a shunting signal and a departure signal are at the same place, they will share a common installation pole. A route indicator will be installed where a track branches into two tracks.

(2) Block Equipment

In the section between Zamyn-Uud and P52 signal station equipped with the tablet block system, we plan to introduce a special automatic block system that does not require intermediate track circuits, using the existing lines for the tablet block system. P52 station will be equipped with necessary signals, power-operated points and track circuits. The control board of the semi-automatic block system for the 1,435mm gauge track to Erenhot will be placed in the signal operation center which is planned to be newly built.

(3) There are two types of interlock system. One is the relay interlock system. The other is the electronic interlock system composed of electronic parts, which facilitates the control of train operation diagram, automatic routing and integration with CTC, ATC and PRC systems. However, introduction of this system does not seem practical for Mongolian Railway where the number of train operation is small, since it requires a large amount of investment, constant temperature control and a high level of maintenance technique. On the other hand, Mongolian Railway has already adopted the relay interlock system on a large scale and experienced in maintenance and trouble shooting; punctual train operation is often disturbed for various reasons; and Mongolian Railway does not intend introduction of CTC, ATC or PRC. For these reasons, we plan to introduce relay interlock equipment at Zamyn-Uud station.

(4) Switching Equipment

We plan to install AC power-operated points with electric heater to prevent freezing in winter.

(5) Track Circuits

Since there are no electrical facilities or transmission lines near the track that would be affected by induction current, we plan to use track circuits of the commercial 50Hz frequency. To improve the maintenance efficiency, we adopt the double track type with duel bonds at the power supply and collection points.

4-5-2 Telecommunication Equipment

(1) Radio Communication Equipment

For the convenience of shunting work, we introduce radio communication equipment for communications between the signal operation center, shunting locomotives and ground crew in the yard.

(2) Talk-back Equipment

We plan to install speakers of the talk-back system near the shunting signals and points to facilitate communications between the ground crew for the shunting work, maintenance and inspection.

(3) Telephone Exchange

We introduce a digital exchange to replace the step-by-step exchange in the telecommunication center which often fails and is short of spare parts. The digital exchange can be installed in a comparatively small space. Removal of the existing exchange will produce not only a space to accommodate the digital exchange but also allowance for future expansion of the facilities.
The digital exchange features the following.

- Small installation space and power consumption
- A variety of subscriber services and easiness of changing subscriber numbers
- High reliability and maintainability

(4) Voice Call Telephone

We plan to introduce the voice call telephone system for communications between the signal operation center and offices for train operation work.

(5) The transmission capacity is inadequate in the 250km section between Zamyn-Uud and P52 signal station. However, no bare wire transmission equipment can additionally be installed in the section. For this reason, it is important to discuss introduction of digital transmission equipment with an optical fiber transmission line laid along the track in order to construct an up-to-date transmission network with high quality.

4-5-3 Electric Power Supply System

(1) Outline

A necessary electric power supply system shall be provided to meet the load demands for the installation of new transshipping facilities at Zamyn-Uud Station.
Two 630kW generators are now out of order and only one 800kW generator is in operation. As an immediate measure, two generators — one of the two 630kW generators that is to be tentatively repaired and the 800kW generator — shall be used to meet the load demands. In 2000, however, two new 750kW generators shall replace both the two 630kW generators (one repaired and in operation and the other unrepairable) and shall be used, together with the 800kW generator as a reserve, to meet the increasing load demands and enhance the reliability of power supply.
For transshipping facilities, lighting poles with mercury lamp projectors shall be planted. Sheltered platforms shall be illuminated from the ceiling.
Yards, including storage tracks and engine run around tracks, shall be illuminated as a whole for work safety. Necessary power distribution lines and transformers shall be provided.
To meet the load increase for residences to be newly built, consideration shall be given to strengthening the power supply for city.

(2) Load Estimate

At present, the load of the generating plant at Zamyn-Uud is approximately 740kW. It is estimated that the load will increase to 1,291kW in 2,000 because of the provision of new transshipping facilities and the addition or repair of various yard buildings. See Table 4-5-1.

Table 4-5-1 Power Load Estimate

Location	Kind of Loads	Load, kW				Remarks
		Lighting	Power	Signal	Total	
Station	New transshipping facilities	34	9	0	43	
	New yard illumination	18	0	0	18	
	New yard buildings	73	81	35	189	
	Existing facilities	150	65	10	225	
	Total	275	155	45	475	
City	New residence	97	24	0	121	
	Existing facilities	380	190	0	570	
	Total	477	214	0	691	
Wayside	Existing facilities	80	20	25	125	
Grand Total		832	389	70	1,291	

(3) Generator

To cope with additional load and aging existing generators, two generators, Nos. 1 and 2 (each, 630kW), shall be replaced with two 750kW ones. At the same time, overage distribution panels and circuit breakers shall be also replaced for enhancing the reliability. The existing generator No. 3 (800kW) shall be used as a reserve.

(4) Distribution Line

To meet the load increase in station yard and city, new distribution lines shall be provided. A 3-line system shall be adopted — station yard, city and wayside lines. They shall be 3-phase, 10kV, and aerial. Copper twisted wires (38 sq. mm) shall be used.

(5) Transformer

Transformers for distribution shall be installed near the major loading points.

(6) Transshipping Facilities Illumination

Transshipping, low-floored platforms shall be illuminated with mercury lamp projectors. The average illumination shall be 10 luxes. Sheltered platforms for covered freight cars shall be illuminated from the ceiling with mercury lamps. The average illumination shall be 100 luxes.

(7) Yard Illumination

Mercury lamp projectors shall be provided to illuminate the storage tracks and engine run around tracks in the yard. The average illumination shall be 1 lux.

(8) Electric Lighting and Power Sources for Various Buildings

Various buildings and residences to be added or repaired shall be provided with electric lighting and power sources.

(9) Electric Power Distribution System

Figure 4-5-1 shows the electric power distribution system as of 2000.

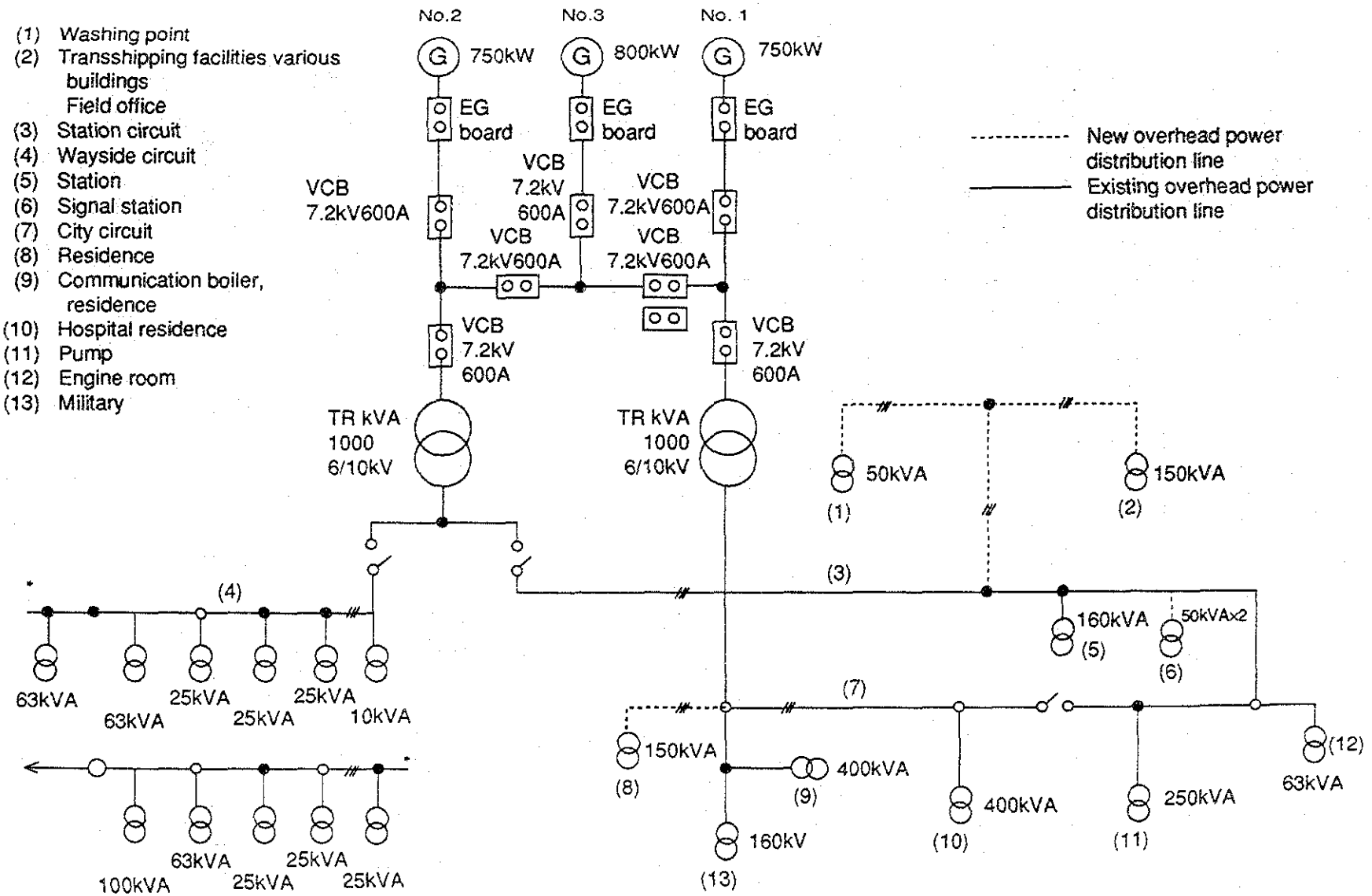


Fig. 4-5-1 Electric Power Distribution System of 2000

4-6 Storage

4-6-1 Basic Policy

On the basis of 4-2 "Cargo Transport Plan" 4-3 "Track and Civil Structure Plan," the team planned the storage facilities taking into consideration the following.

(1) The cargo transshipment facilities are planned at the border station of Zamyn-Uud where train operation on the normal schedule seems to be difficult.
(2) The railway line consists of a single track that will produce substantial effects when train operation is delayed.
(3) The station is under severe natural conditions with strong winds, sandy storms, and a continental climate in the backwater area.

4-6-2 Preconditions

Preconditions for the storage plan are as follows.

(1) Transport plan in 4-2.
(2) Track layout of the yard described in 4-3 "Track and Civil Structure."
(3) Cargo handling equipment in explained in 4-4 "Cargo Transshipment Equipment."

4-6-3 Storage Plan

(1) Cargos in Wagon

In case the train operation and the wagon movement management are in disorder, the team plannd storage facilities on the basis of the basic policy in 4-6-1. The team planned two warehouses under the roof at the ends of the high deck platform to store valuable cargos remained in the freight cars on the 1,520mm and 1,435mm gauge tracks. The size of these warehouses was determined to allow storage of all the cargos loaded on a wagon.

(2) Cargos in Gondola Car

In case the normal train operation or wagon flow control is disturbed, the team planned a temporary storage space as described in 4-3 "Track and Civil Structure."

(3) Cargos in Container

In case the normal train operation or wagon flow control is disturbed, the team planned a temporary storage space as described in 4-3 "Track and Civil Structure."

(4) Fences to Prevent Invasion to Cargo Transshipment Platforms

The team planned to install fences around the cargo transshipment platforms to prevent invasion of unauthorized people and burglary.

4-7 Management Office and Crew Houses

4-7-1 Basic Policy

The team planned efficient management offices and crew houses on the basis of Chapter 9 "Management and Operation Plan," utilizing as many existing facilities as possible. In planning these facilities, the team observed the convenience for future expansion, and also paid due attention to the following.

1) Management and operation plan
2) Facility arrangement to allow efficient station activities
3) Utilization of existing facilities
4) Durability against the severe natural conditions
5) Possibility for future expansion

4-7-2 Management Office

(1) Preconditions

The preconditions for planning the management offices are as follows.

1) Employee recruitment plan according to Chapter 9 "Management and Operation Plan."
2) Existing facilities
   Table 4-7-1 shows the possibility of utilization of the existing facilities.
3) Structure
   The team planned the facilities basically according to the standards of Mongolian Railway.

Table 4-7-1 Existing Facilities

No.	Name	Area (m^2)	Possibility of utilization	Remarks
1	Passenger house	581	Y	Y means reusable
2	Customs office	296	Y	
3	Tower	69	Y	
4	Toilet	26	Y	
5	Customs warehouse	49	Y	
6	Baggage warehouse	93	Y	
7	Refrigerator room	5.2	Y	
8	Point operation center No. 3	9	Y	
9	Point operation center No. 1	7	Y	
10	Boiler room	122	Y	
11	Substation	18	Y	
12	Maintenance station	679	Y	
13	Locomotive shed	1,708	Y	To be remodelled
14	Fuel warehouse	23	Y	
15	Warehouse and roofed cargo platform	750	Y	
16	Oil filling bridge	—	Y	
17	Light oil tank	—	Y	
18	Point operation center No. 4	9	Y	
19	Power plant	437	Y	
20	Point operation center No. 2	9	Y	

(2) Plan of Offices and Other Houses

According to the preconditions, the team planned offices and houses to efficiently carry out the cargo transshipment work.

Table 4-7-2 lists major buildings including the offices for freight handling, storage house, signal equipment rooms, site crew houses, and parking and maintenance sheds (see Figure 4-7-1). The basis of floor space calculation of major facilities is shown in appendix 4-7-1 and 2 in for a reference.

Table 4-7-2 Houses to be Built or Remodelled

	Name	Area (m^2)	Remarks
1	Site office	600	To the side of 1,520mm gauge marshalling tracks in the cargo transshipment yard
2	Signal operation room	400	Near the station main office
3	Signal equipment room (A)	30	Near the 1,435mm gauge marshalling tracks
4	Signal equipment room (B)	30	To the side of 1,435mm gauge marshalling tracks in the cargo transshipment yard
5	Site crew house	40	Near the 1,435mm gauge marshalling tracks in the cargo transshipment yard
6	Garage for truck cranes	340	To accommodate two cars
7	Garage for reach stackers	340	To accommodate two stackers
8	Cargo storage house	600	300 m^2 × 2
9	Depot (1,520mm)	1,708	To be remodelled
10	Depot (1,435mm)	300	20 m × 15 m
11	Wagon cleaning shed	1,250	50 m × 25 m

4-7-3 Crew Houses

(1) Preconditions

The preconditions for planning crew houses are as follows.

1) Number of employees according to Chapter 9 "Operation and Management Plan."
2) New houses are to be constructed to accommodate the number of employees increased as the result of construction of the cargo transshipment facilities.
3) The unit space of these houses is to be determined to reflect the severe natural conditions in the backward area referring to the standard for the employee residences of Mongolian Railway.
4) The houses for the managerial staff after the completion of the cargo transshipment facilities will be built in advance. These houses are to be appropriated to house the managerial staff of Mongolian Railway in the construction work.

(2) Number of Houses to be Built

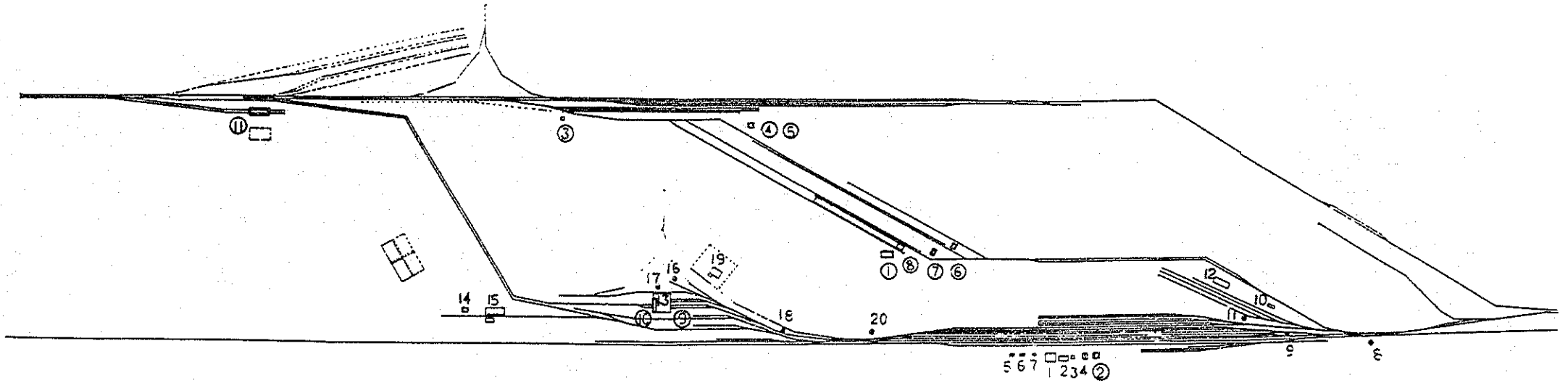
Since it is required to give houses to 165 employees according to Chapter 9 "Operation and Management Plan," the team planned to build 70 houses, unit floor space 40m^2, for family use and 100 houses, unit floor space 20m^2, for unmarried employes.

Appendix 4-7-1 Basis for Floor Space Calculation of Site Offices and Houses (reference)

	Item	Area (m^2)	Basis of calculation
1	Main office		
	Assistance station master and others	70	3.2N + 7 3.2 × 20 + 7 ≃ 70 m^2 N = Assistant station masters 2, Section chiefs 4 × 4 ≃ 20
	Space for meeting	25	
2	Site crew houses		
	Operation	20	1.1m^2/person × 12 persons
	Handling	20	1.1m^2/person × 11 persons
	Other cargos	30	1.1m^2/person × 19 persons
	Chinese inspectors	20	1.1m^2/person × 11 persons
3	Meeting room	30	
4	Computer room	10	
5	Copying room	10	
6	Warehouse	30	Library
7	Closet	100	Cargo staff 234 persons × 0.4 m^2/person ≃100
8	Rest room	40	
9	Shower room	20	
10	Toilet	20	Large and small, two each
11	Catering room	20	With a food storage room
12	Tool room	30	For materials and parts
13	Garage	40	For two cars
14	Corridor, stairs and others	Rest	
	Total	600	

Appendix 4-7-2 Basis of Calculation of Signal Operation Room (reference)

Item		Area (m^2)	Basis of calculation
1	Relay room	200	Relay racks and equipment
2	Signal operation room	100	Control board and desks
3	Rest room	20	
4	Meeting room	25	
5	Toilet	15	Large and small toilets, two each
6	Stairs and others	Rest	
	Total	400	



Existing buildings

No	Name	Area (m²)
1	Station main office	581
2	Customs office	298
3	Tower	69
4	Toilet	26
5	Customs warehouse	49
6	Baggage warehouse	93
7	Refrigerator room	5
8	Point operation center No.3	9
9	Point operation center No.1	9
10	Boiler room	122
11	Substation	18
12	Maintenance center	679
13	Locomotive shed	1,708
14	Oil storage house	23
15	Warehouse and roofed platform	750
16	Oil filling bridge	---
17	Diesel oil tank	---
18	Point operation center No.4	9
19	Power plant	437
20	Point operation center No.2	9

Buildings to be built or remodelled

No	Name	Area (m²)
①	Site office	600
②	Signal operation room	400
③	Signal equipment room (A)	30
④	Signal equipment room (B)	30
⑤	Site crew house	40
⑥	Garage for truck cranes	210
⑦	Garage for reach stackers	210
⑧	Cargo storage house	600
⑨	Depot (1,520 mm) (to be remodelled)	1,708
⑩	Depot (1,435 mm)	300
⑪	Wagon cleaning shed	1,250

Fig. 4-7-1 Building Plan

Chapter 5

CHAPTER 5 ALTERNATIVE PLANS

5-1 General

In planning the cargo transshipment facilities at Zamyn-Uud station, the team discussed the methods of transshipment as described in Chapter 4. The major point was the choice of a gantry crane or the combination of reach stackers and truck cranes to handle containers and cargos in gondola car, which shall be determined taking into consideration not only the advantages and disadvantages from the technical viewpoints but also the results of economic and financial analyses of the facilities.

The difference between Plan 1 (gantry crane) and Plan 2 (reach stacker/truck crane) is only the handling equipment for containers and cargos in gondola car. Both Plans envisages therefore the same equipment to transship cargos in wagon, access to the cargo transshipment facilities, tracks, signal and telecommunication equipment, rolling stock washing equipment, maintenance equipment, station buildings and others.

Below explained are the methods and facilities adopted in Plans 1 and 2.

5-2 Plan 1 (Gantry crane)

(1) Method of Transshipment

1) Cargos in wagon are transshipped with small size forklifts and belt conveyors, supplemented by manual work where necessary.
2) Containers are transshipped with a gantry crane with attachments for container transshipment.
3) Cargos in gondola car are transshipped with the gantry crane.

(2) Platforms for Transshipment Work

1) Cargos in wagon : A roofed high concrete platform: width 15m, length 240m, height from rail, 1.10m
2) Containers : A low concrete platform : width 9.5m, length 430m
3) Cargos in gondola car : A concrete platform : width 11m, length 240m

(3) Civil Structure (other than platforms)

1) Foundation for gantry crane
2) Fences, gates and drainage
3) Track facilities : Tracks (gauges 1,520mm and 1,435mm), points, car stops and a crossing
4) Roads for operation and access
5) Water supply equipment (an elevated water tank)
6) Rolling stock washing facilities

(4) Architecture

1) Cargo handling site office $600m^2$
2) Signal operation center $400m^2$
3) Signal equipment room $30m^2$
4) Site crew house (including the signal equipment room)

5) Residential houses (for 180 employees) 8,100m^2
6) Machine storage house 210m^2× 2
7) Cargo warehouse 600m^2
8) Depot maintenance shed (existing) 1,708m^2
– do – (to be newly built) 300m^2
9) Car washing house 1,250m^2

(5) Cargo Handling Equipment
1) RMG container crane (rail-wheel type), span 19m
2) Gantry crane, 20t
3) Forklift, 1.5t
4) Portable conveyor
5) Auxiliary facilities and parts
Oiling facilities
Rolling stock maintenance facilities
Spare parts for operation of two years

(6) Signal and Telecommunication Equipment
1) Block equipment
2) Signal equipment
3) Interlock equipment
4) Power supply equipment
5) Switching equipment
6) Track circuits
7) Transmission lines
8) Air conditioning equipment
9) Radio communications equipment
10) Talk-back equipment
11) Telephone exchange
12) Voice communication equipment

(7) Power Equipment
1) Generator
2) Lighting instruments
3) Power supply lines

5-3 Plan 2 (Reach stacker)

(1) Method of Transshipment
1) Cargos in wagon are transshipped by the same method as in Plan 1.
2) Containers are transshipped with a reach stacker.
3) Cargos in gondola car are transshipped with a truck crane.

(2) Platforms for Transshipment Work

1) Cargos in wagon : Same as in Plan 1
2) Containers : A low concrete platform: width 36m, length 430m
3) Cargos in gondola car : A low concrete platform : width 20m, length 240m

(3) Civil Structure (other than platforms)

1) Foundation for gantry crane is not necessary
2) Fences, gates and drainage : Same as in Plan 1
3) Track facilities : – do –
4) Roads for operation and access : – do –
5) Water supply equipment : – do –
6) Rolling stock washing facilities : – do –

(4) Architecture : Same as in Plan 1

(5) Cargo Handling Equipment

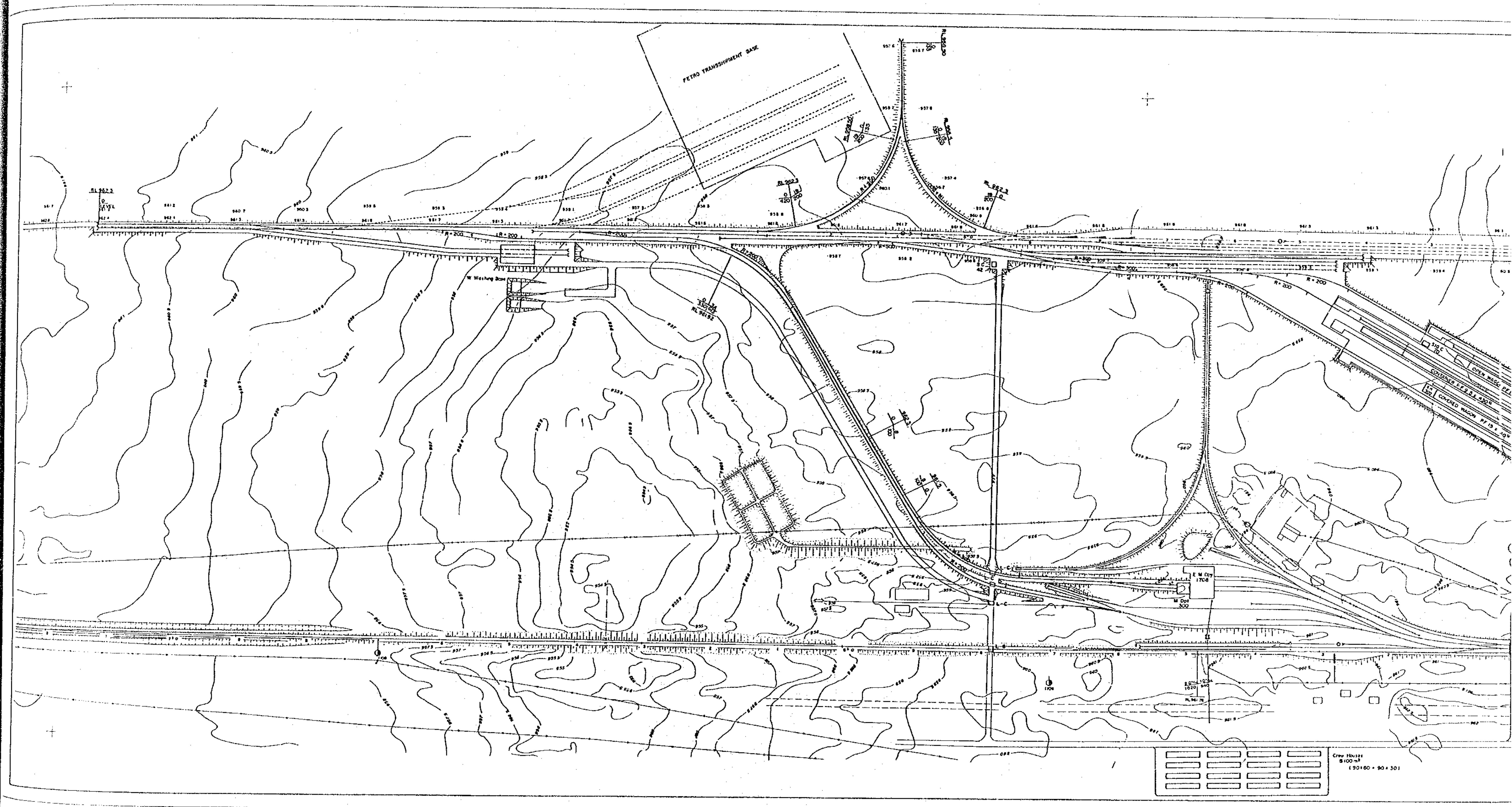
1) Reach stacker
2) Track crane, 35t
3) Forklift : Same as in Plan 1
4) Portable conveyor : – do –
5) Auxiliary facilities and parts : – do –

(6) Signal and Telecommunication Equipment : Same as in Plan 1

(7) Power Equipment : Same as in Plan 1

5-4 Layout of the Cargo Transshipment Facilities in the Year 2000

Figures 5-4-1 and 5-4-2 show the layout of cargo transshipment facilities in the year 2000 in Plan 1 and Plan 2, respectively.



PETRO TRANSSHIPMENT BASE
W Washing Base
CONTAINER
COVERED WAGON
Crew Houses
(90+60+90+30)

2000 Year Plan
Track to be adjusted, 1520 to 1435㎜ (Urgent Project)
Existing Facility
Petro Track Line to be done by others

S.C : Signal Cabin (42㎡)
M.Dept: Locomotive Maintenance Depot (300㎡ or 1708㎡)
M.O : Main Administration Office (150㎡×2F)
S.H : Storage House (300㎡)
P.F : Platform

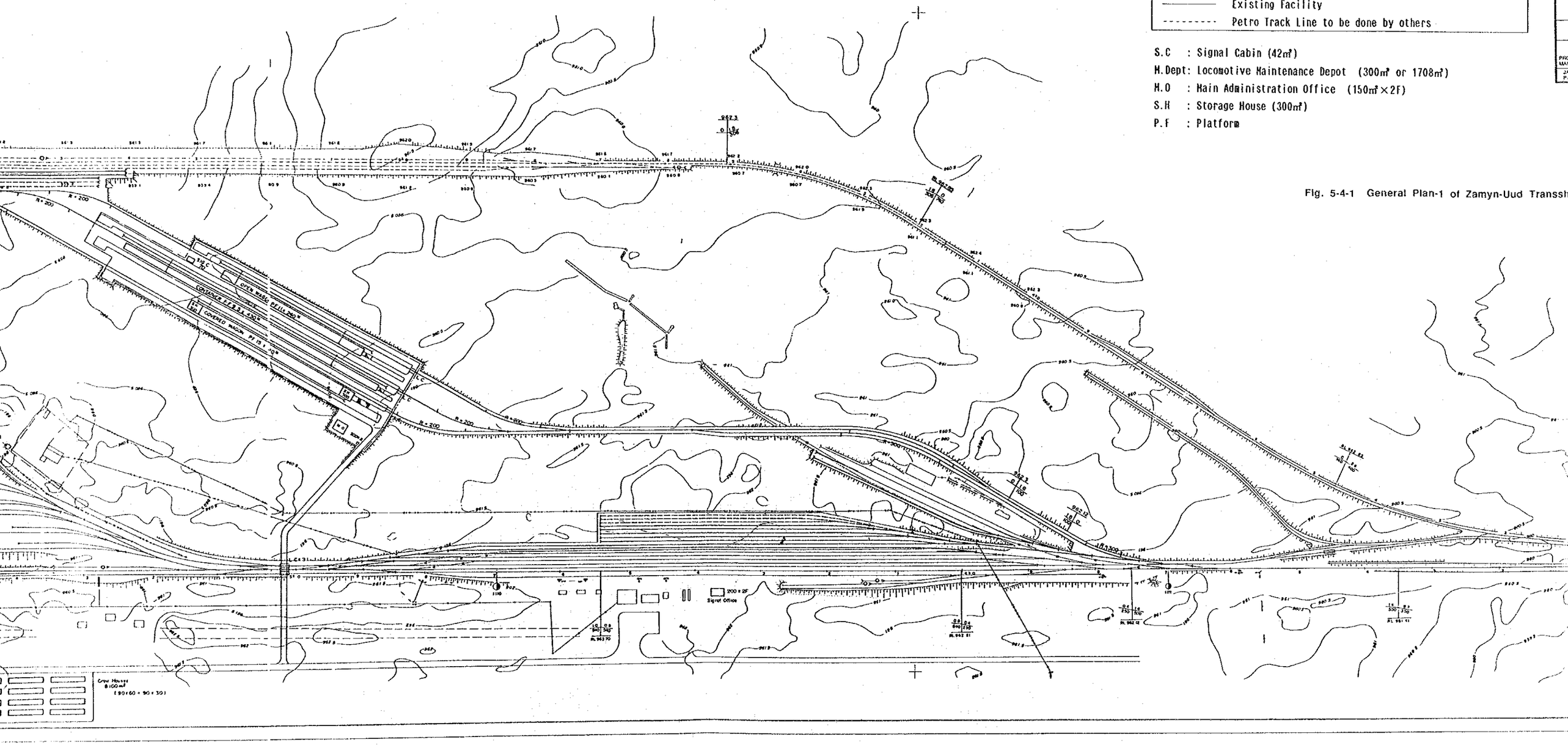
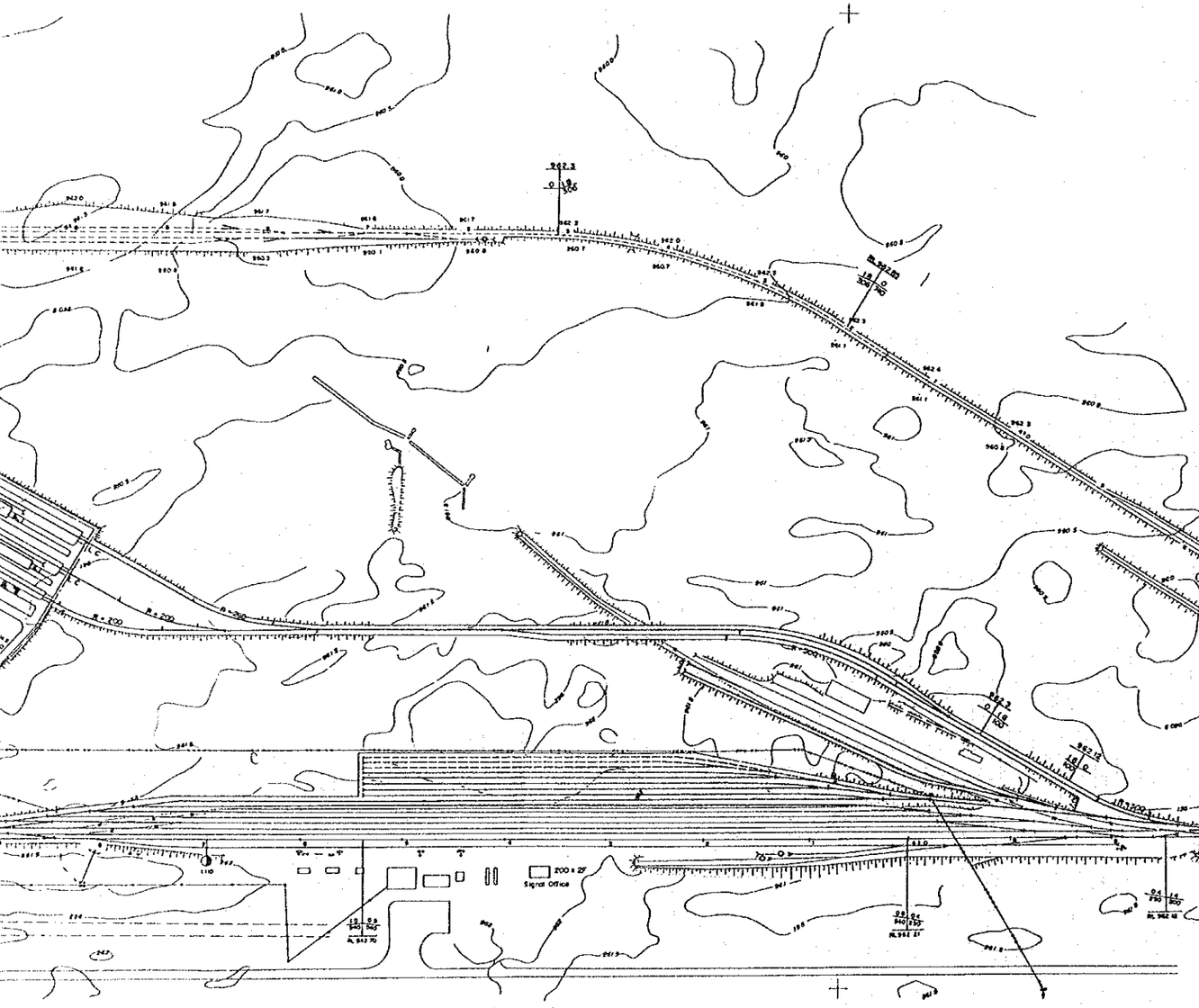


Fig. 5-4-1 General Plan-1 of Zamyn-Uud Transsh



2000 Year Plan
Track to be adjusted, 1520 to 1435㎜ (Urgent Project)
Existing Facility
Petro Track Line to be done by others

S.C : Signal Cabin (42㎡)
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MINISTRY OF TRADE AND INDUSTRY AND MONGOLIAN RAILWAY, MONGOLIA			
THE IMPROVEMENT PLAN FOR TRANSSHIPMENT FACILI FACILI TIES AT ZAMYN-UUD STATION IN MONGOLIA			
GENERAL PLAN – 1 (2000 year)			
PROJECT MANAGER	DESIGNED BY		DRAWING NO.
	DATE		
	SCALE	1: 2000	
JAPAN RAILWAY TECHNICAL SERVICE PACIFIC CONSULTANTS INTERNATIONAL JAPAN			

Fig. 5-4-1 General Plan-1 of Zamyn-Uud Transshipment Facility (2000 year)